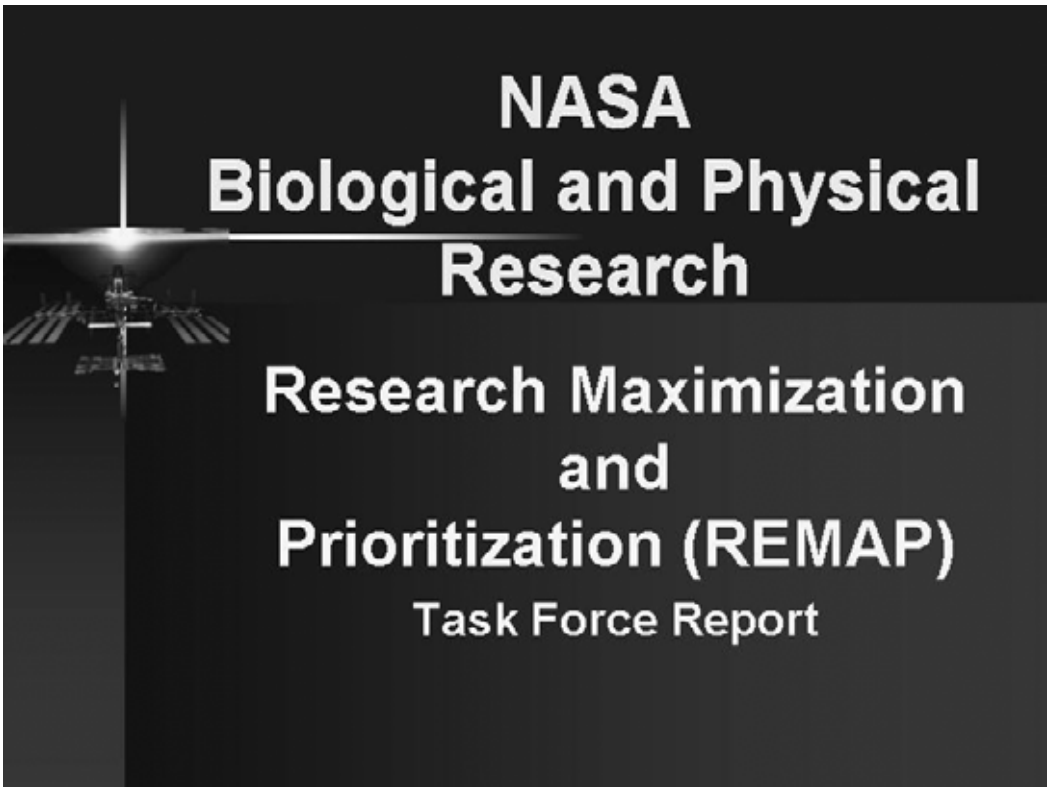
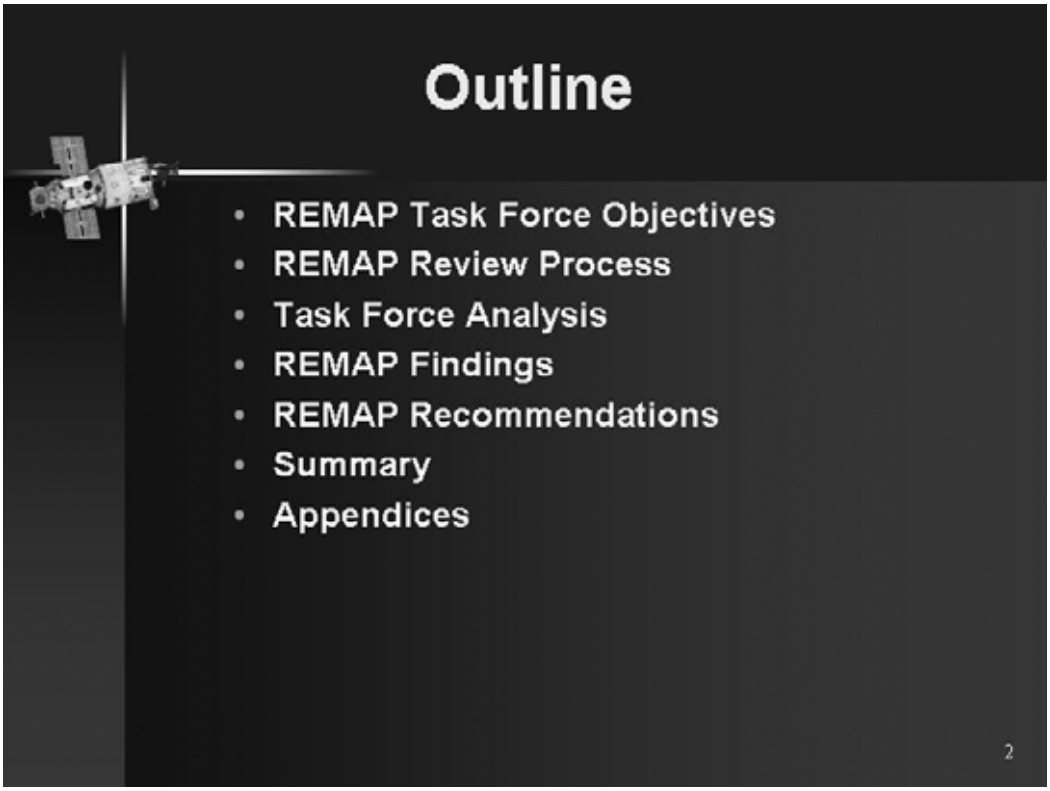
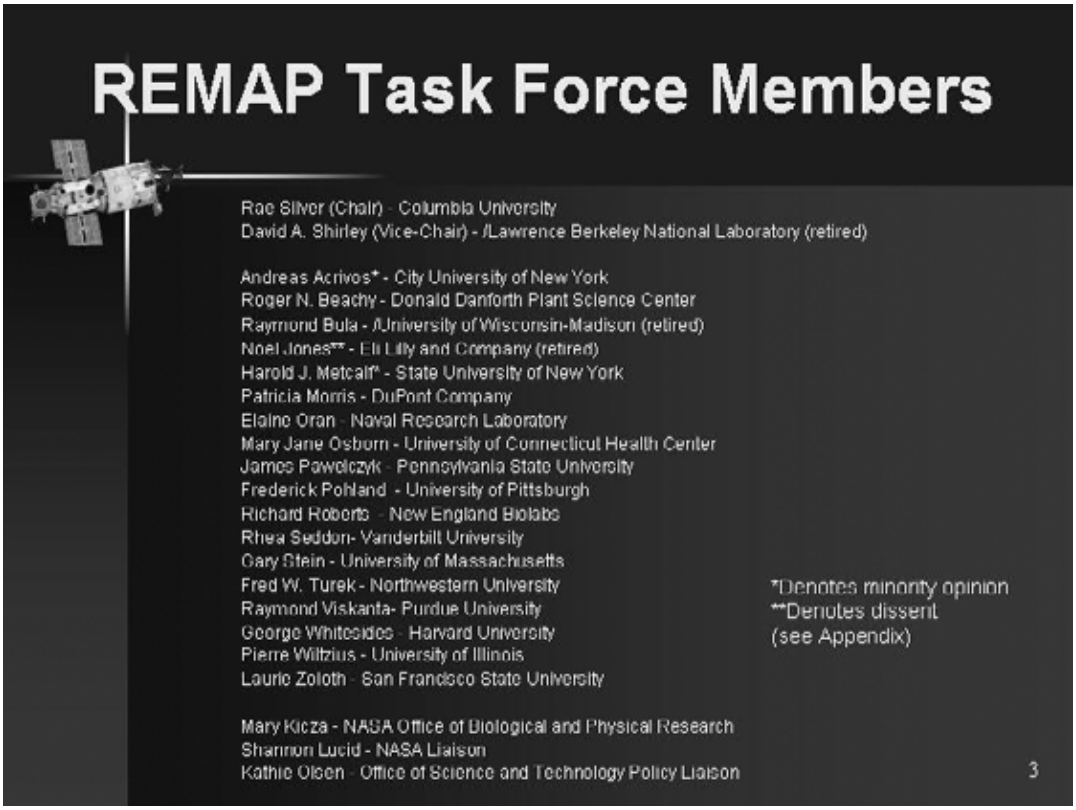
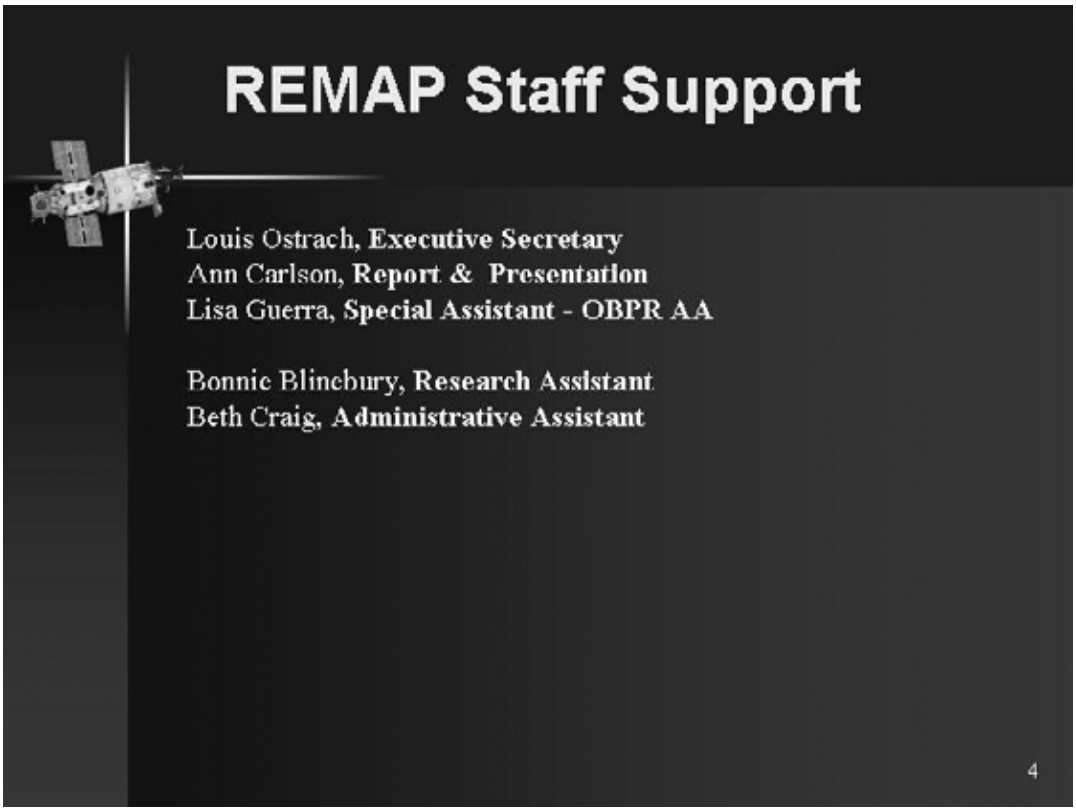
APPENDIX C: Briefing to NASA Advisory Council by ReMAP






REMAP Task Force Members
Rae Silver (Chair) - Columbia University
David A. Shirley (Vice-Chair) - /Lawrence Berkeley National Laboratory (retired)
Andreas Acrivos* - City University of New York
Roger N. Beachy - Donald Danforth Plant Science Center
Raymond Bula - /University of Wisconsin-Madison (retired)
Noel Jones** - Eli Lilly and Company (retired)
Harold J. Metcalf* - State University of New York
Patricia Morris - DuPont Company
Elaine Oran - Naval Research Laboratory
Mary Jane Osborn - University of Connecticut Health Center
James Powelczyk - Pennsylvania State University
Frederick Pohland - University of Pittsburgh
Richard Roberts - New England Biolabs
Rhea Seddon- Vanderbilt University
Gary Stein - University of Massachusetts
Fred W. Turek - Northwestern University
Raymond Viskanta- Purdue University
George Whitesides - Harvard University
Pierre Wiltzius - University of Illinois
Laurie Zoloth - San Francisco State University
*Denotes minority opinion
**Denotes dissent
(see Appendix)
Mary Kicza - NASA Office of Biological and Physical Research
Shannon Lucid - NASA Liaison
Kathie Olsen - Office of Science and Technology Policy Liaison
3


REMAP Staff Support
Louis Ostrach, Executive Secretary
Ann Carlson, Report & Presentation
Lisa Guerra, Special Assistant - OBPR AA
Bonnie Blinebury, Research Assistant
Beth Craig, Administrative Assistant
4

Schedule of Activities

Date	Location	Activity
April 2-3	NASA HQ	Introductions, fact finding
April 3-22		Homework
April 19	New York, NY	Sub-committee meeting with International Partners
April 23-24	NASA HQ	Prioritization of science research within OBPR
April 25-May 15		Homework
May 16-17	NASA HQ	Review or Implementation options, report preparation
May 18-May 31		Writing from home
June 5	NASA HQ	Draft REMAP report not ready: Requested extension granted
July 10	NASA HQ	Report delivered to NASA Advisory Council

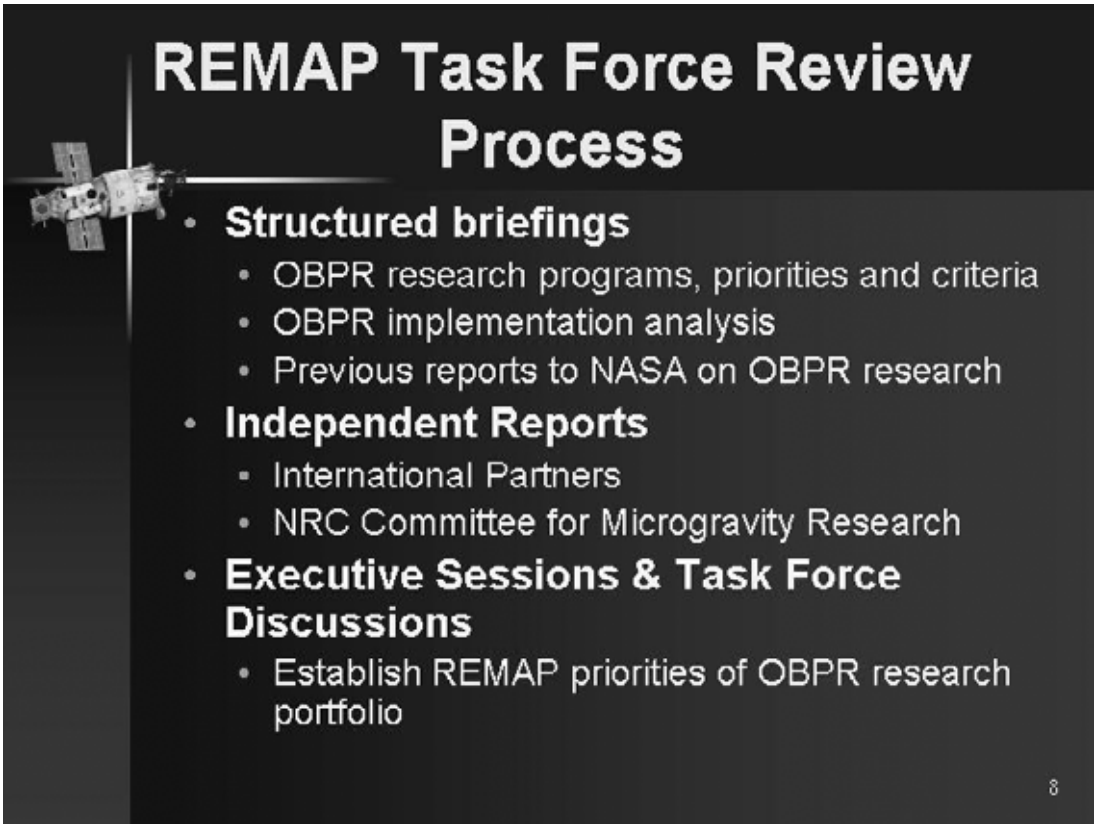
5

Background

- President's FY2003 Budget Request:
  - NASA is to engage the scientific community and establish high-priority science objectives for OBPR
  - Focus on improving scientific productivity
- ISS Management and Cost Evaluation (IMCE) Task Force Recommendation:
  - OBPR to establish scientific research priorities and,
  - Develop executable research program consistent with those priorities

6


Overall REMAP Objectives
• Assess research priorities and productivity for the entire scientific, technological, and commercial portfolio of NASA's Biological and Physical Research Enterprise
• Provide recommendations on how to achieve the greatest progress in high-priority research
7


REMAP Task Force Review Process
• Structured briefings
• OBPR research programs, priorities and criteria
• OBPR implementation analysis
• Previous reports to NASA on OBPR research
• Independent Reports
• International Partners
• NRC Committee for Microgravity Research
• Executive Sessions & Task Force Discussions
• Establish REMAP priorities of OBPR research portfolio
8

Input (non-NASA): Previous Reviews - Bioastronautics and Fundamental Biology Divisions

- A Strategy for Space Biology and Medical Sciences for the 1980s and 1990s, Committee on Space Biology and Medicine, Space Science Board, NRC,1987
- Assessment of Programs in Space Biology and Medicine,Committee on Space Biology and Medicine, Space Studies Board, NRC, 1991
- Radiation Hazards to Crews of Interplanetary Missions: Biological Issues and Research Strategies, Task Group on Biological Effects of Radiation, Space Studies Board, NRC, 1996
- Advanced Technology for Human Support in Space, Aeronautics and Space Engineering Board, Committee on Advanced Technology for Human Support in Space, NRC, 1997.
- A Strategy for Research in Space Biology and Medicine in the New Century, Committee on Space Biology and Medicine, Space Studies Board, NRC, 1998
- Future Biotechnology Research on the International Space Station, Space Studies Board, Task Group for the Evaluation of NASA's Biotechnology Facility for the International Space Station, Space Studies Board, NRC, 2000
- Review of NASA's Biomedical Research Program, Committee on Space Biology and Medicine, Space Studies Board, NRC, 2000
- Safe Passage: Astronaut Care for Exploration Missions, Committee on Creating a Vision for Space Medicine During Travel Beyond Earth Orbit, Board on Health Sciences Policy, IOM, 2001.

9

Input (non-NASA): Previous Reviews - Physical Sciences Division

- Toward a Microgravity Research Strategy. Committee on Microgravity Research, Space Studies Board, NRC, 1988
- Space Science in the Twenty-First Century: Imperatives for the Decades 1995 to 2015—Fundamental Physics and Chemistry, Task Group on Fundamental Physics and Chemistry, Space Studies Board, NRC,1988
- Microgravity Research Opportunities for the 1990's, Committee on Microgravity Research, Space Studies Board, NRC, 1995
- Future Materials Science Research on the International Space Station National Materials Advisory Board, NRC, 1997
- Microgravity Research in Support of Technology for the Human Exploration and Development of Space and Planetary Bodies, Committee on Microgravity Research, Space Studies Board, NRC, 2000
- Future Biotechnology Research on the International Space Station, Task Group for the Evaluation of NASA's Biotechnology Facility for the International Space Station, NRC, 2000
- The Mission of Microgravity and Physical Sciences Research at NASA, Committee on Microgravity Research, Space Studies Board, NRC, 2000
- Readiness Issues Related to Research in the Biological and Physical Sciences on the International Space Station, Task Group on Research on the International Space Station, Space Studies Board, NRC, 2001
- ISS/IMCE Task Force Report, NASA, 2001

10

Input (non-NASA): Previous Reviews - Research Integration Division (Space Product Development)

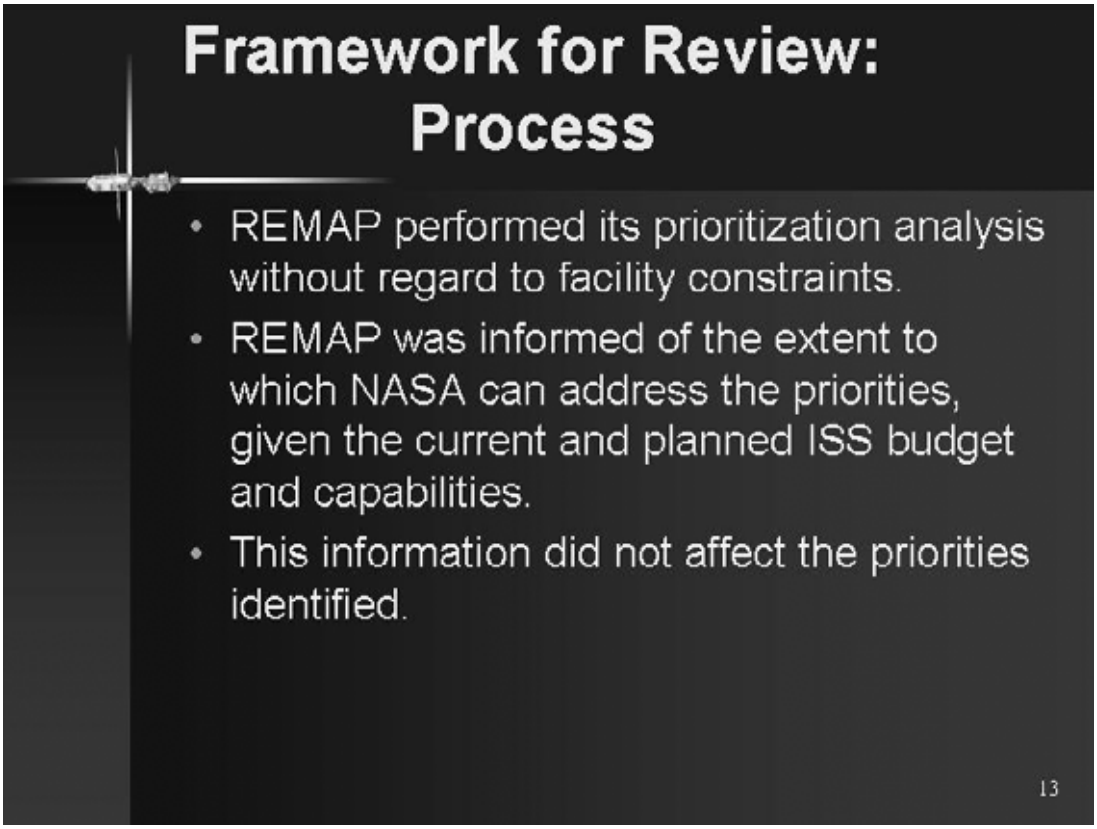
- A Review of the Centers for the Commercial Development of Space: Concept and Operation, National Academy of Public Administration (NAPA) 1994
- Engineering Research and Technology Development on the Space Station, National Research Council, 1996
- The International Space Station Commercialization Study, Potomac Institute for Policy Studies, 1997
- Reflections on the Commercial Space Center (CSC) Program, National Academy of Public Administration, June, 1998.
- Commercial Space Act, Public Law 105-303, 1998
- Commerce and the International Space Station, NASA commissioned KPMG report, November, 1999 (http://commercial.hq.nasa.gov)
- Future Biotechnology Research on the International Space Station, Space Studies Board, Task Group for the Evaluation of NASA's Biotechnology Facility for the International Space Station, Space Studies Board, NRC, 2000
- X-ray Crystallography Facility at the Center for Biophysical Sciences and Engineering, University of Alabama at Birmingham, (2000), prepared by an external review panel commissioned by NASA management

11

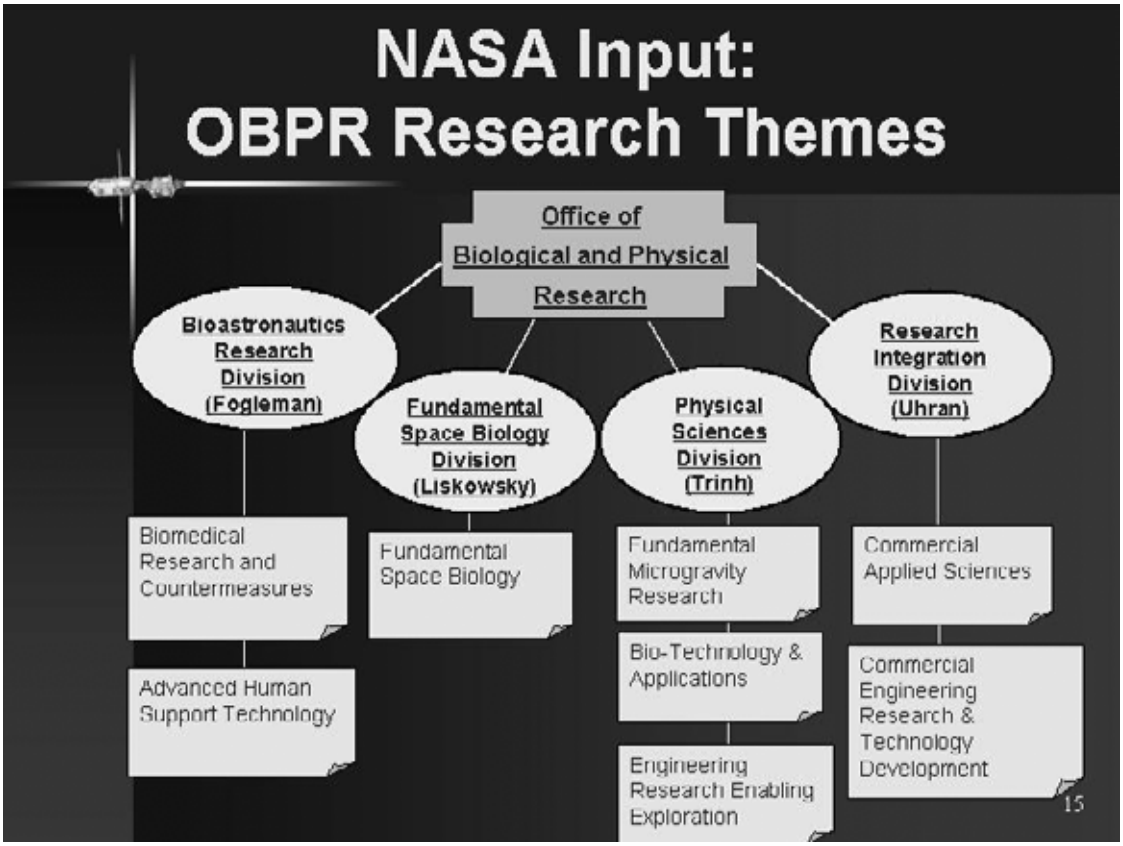
Input (non-NASA): Previous Reviews - Setting Science Priorities for Space Research

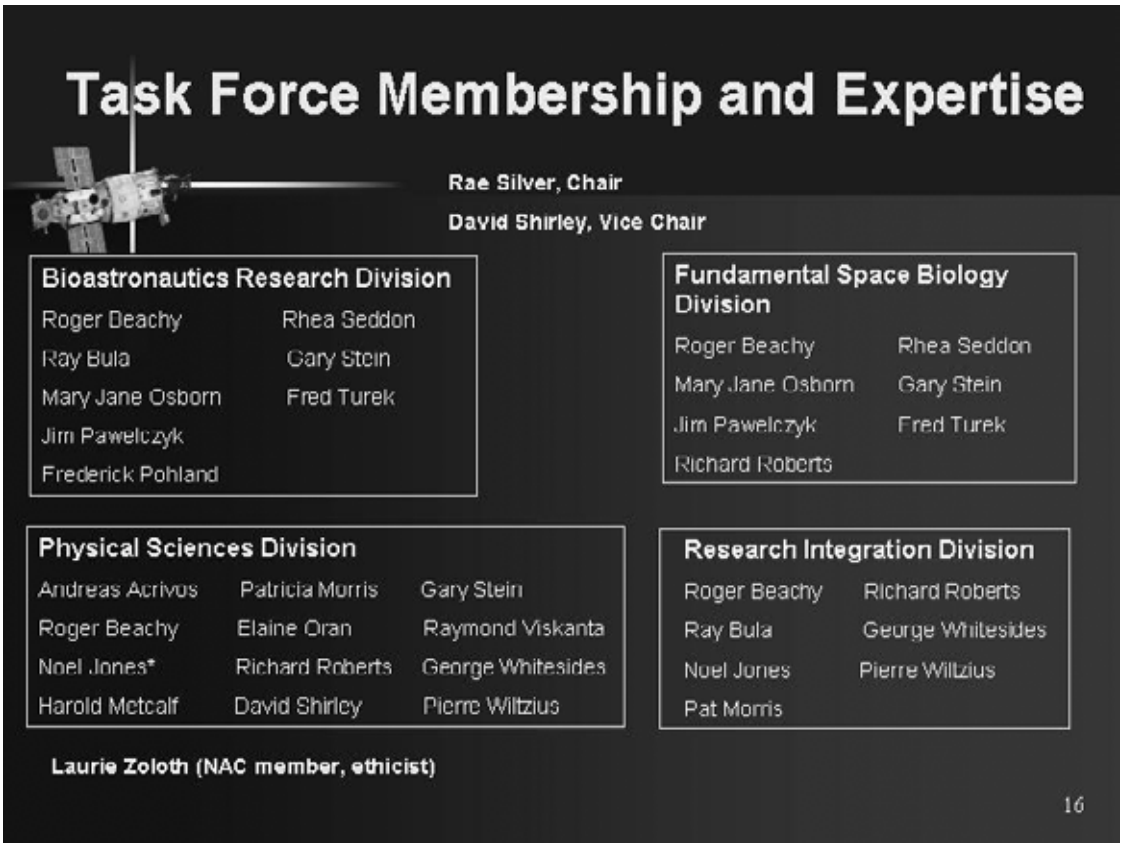
- Setting Priorities for Space Research: Opportunities and Imperatives, Task Group on Priorities in Space Research, Space Studies Board, NRC, 1992
- Setting Priorities for Space Research: An Experiment in Methodology, Task Group on Setting Priorities for Space Research, Space Studies Board, NRC, 1995
- Institutional Arrangements for Space Station Research, Aeronautics and Space Engineering Board, Space Studies Board, NRC, 1999
- Setting Priorities and Coordinating Federal R&D Across Fields of Science: A Literature Review; Executive Summary and Annotated Bibliography, National Science Board DRU-2286/1-NSF, RAND, April 2000
- Federal Research Resources: A Process for Setting Priorities, National Science Board, October 11, 2001
- Federally Funded Research: Decisions for a Decade (Chapter 5, Priority Setting in Science): U. S. Congress, Office of Technology Assessment, OTA-SET-490 (Washington, DC: U. S. Government Printing Office, May 1991)

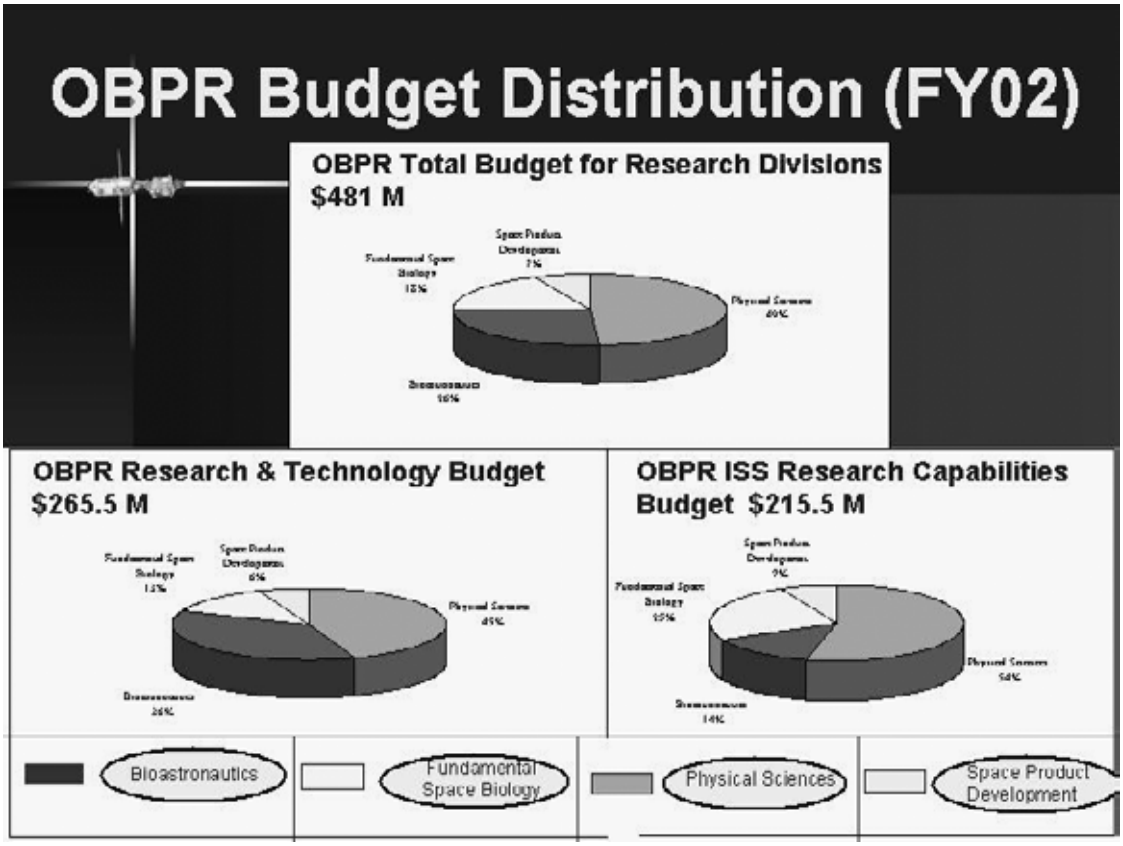
12

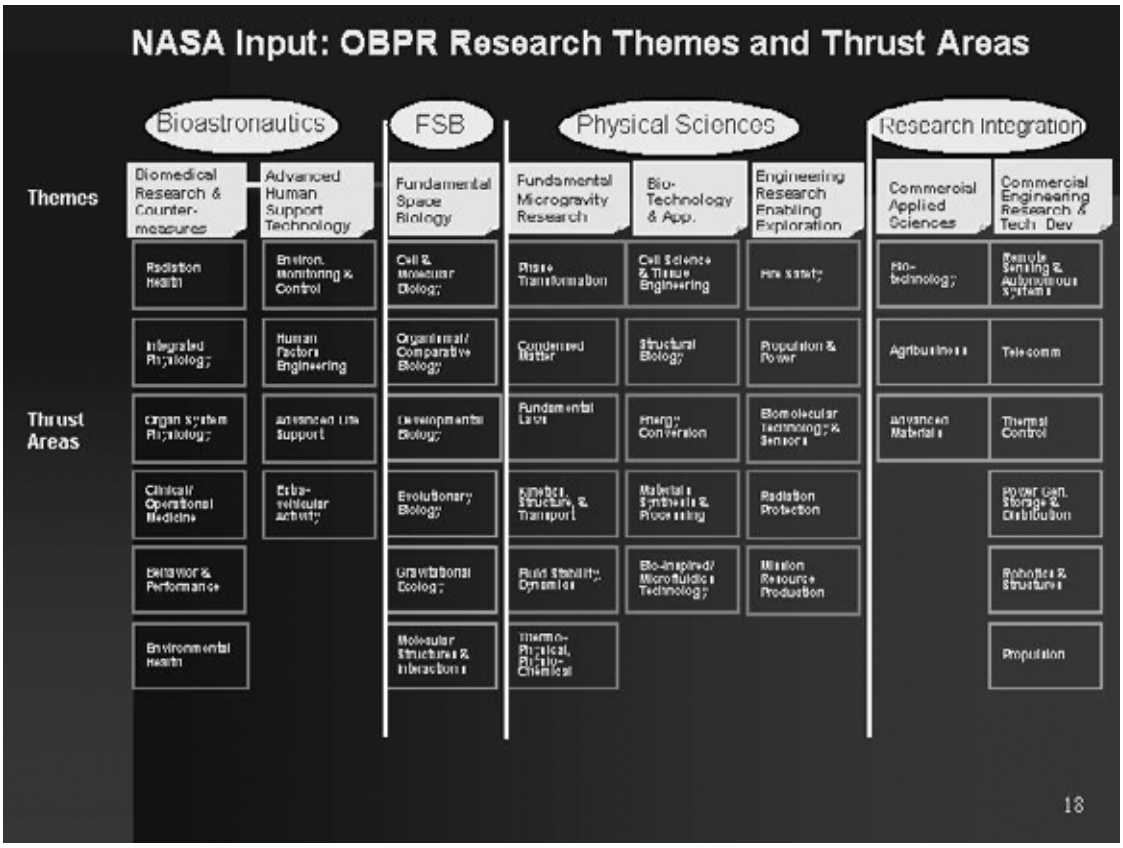

Framework for Review: Process
• REMAP performed its prioritization analysis without regard to facility constraints.
• REMAP was informed of the extent to which NASA can address the priorities, given the current and planned ISS budget and capabilities.
• This information did not affect the priorities identified.
13


Framework for Review: Identifying Best Research
• REMAP was charged to identify the best science that could be done by OBPR.
• The diversity of expertise and limited meeting times constrained REMAP to focus on the existing OBPR research program.
14


NASA Input:
OBPR Research Themes
Office of Biological and Physical Research
Bioastronautics Research Division (Fogleman)
Fundamental Space Biology Division (Liskowsky)
Physical Sciences Division (Trinh)
Research Integration Division (Uhran)
Biomedical Research and Countermeasures
Advanced Human Support Technology
Fundamental Space Biology
Fundamental Microgravity Research
Bio-Technology & Applications
Engineering Research Enabling Exploration
Commercial Applied Sciences
Commercial Engineering Research & Technology Development
15


Task Force Membership and Expertise
Rae Silver, Chair
David Shirley, Vice Chair
Bioastronautics Research Division
Roger Beachy
Rhea Seddon
Ray Bula
Gary Stein
Mary Jane Osborn
Fred Turek
Jim Pawelczyk
Frederick Pohland
Fundamental Space Biology Division
Roger Beachy
Rhea Seddon
Mary Jane Osborn
Gary Stein
Jim Pawelczyk
Fred Turek
Richard Roberts
Physical Sciences Division
Andreas Acrivos
Patricia Morris
Gary Stein
Roger Beachy
Elaine Oran
Raymond Viskanta
Noel Jones*
Richard Roberts
George Whitesides
Harold Metcalf
David Shirley
Pierre Wiltzius
Research Integration Division
Roger Beachy
Richard Roberts
Ray Bula
George Whitesides
Noel Jones
Pierre Wiltzius
Pat Morris
Laurie Zoloth (NAC member, ethicist)
16


OBPR Budget Distribution (FY02)
OBPR Total Budget for Research Divisions
$481 M
OBPR Research & Technology Budget
$265.5 M
OBPR ISS Research Capabilities
Budget $215.5 M
Bioastronautics
Fundamental Space Biology
Physical Sciences
Space Product Development


NASA Input: OBPR Research Themes and Thrust Areas
Bioastronautics
FSB
Physical Sciences
Research Integration
Themes
Thrust Areas
Biomedical Research & Countermeasures
Advanced Human Support Technology
Fundamental Space Biology
Fundamental Microgravity Research
Bio-Technology & App.
Engineering Research Enabling Exploration
Commercial Applied Sciences
Commercial Engineering Research & Tech Dev
Radiation Health
Environ. Monitoring & Control
Cell & Molecular Biology
Phase Transformation
Cell Science & Tissue Engineering
Bio-technology
Remote Sensing & Autonomous Systems
Integrated Physiology
Human Factors Engineering
Organismal/ Comparative Biology
Condensed Matter
Structural Biology
Propulsion & Power
Agribusiness
Telecomm
Organ System Physiology
Advanced Life Support
Developmental Biology
Fundamental Laws
Energy Conversion
Biomolecular Technology & Sensors
Advanced Materials
Thermal Control
Clinical/ Operational Medicine
Extra-vehicular activity
Evolutionary Biology
Kinetics, Structure, & Transport
Material Synthesis & Processing
Radiation Protection
Power Gen. Storage & Distribution
Behavior & Performance
Gravitational Ecology
Fluid Stability Dynamics
Bio-inspired/ Microfluidics Technology
Mission Resource Production
Robotics & Structures
Environmental Health
Molecular Structure & Interactions
Thermo-Physical, Physico-Chemical
Propulsion
18

REMAP Task Force According to 8 OBPR Research Themes

Biomedical Research & Countermeasures
Roger Beachy
Mary Jane Osborn
Jim Pawelczyk
Rhea Seddon
Gary Stein
Fred Turek

Advanced Human Support Technology
Ray Bula
Jim Pawelczyk
Frederick Pohland
Rhea Seddon
Fred Turek
Raymond Viskanta

Fundamental Space Biology
Roger Beachy
Mary Jane Osborn
Jim Pawelczyk
Richard Roberts
Rhea Seddon
Gary Stein
Fred Turek

Fund. Microgravity Research
Andreas Acrivos
Harold Metcalf
Patricia Morris
Elaine Oran
David Shirley
George Whitesides
Pierre Wiltzius
Raymond Viskanta

Biotechnology and Applications
Roger Beachy
Noel Jones
Elaine Oran
Richard Roberts
Gary Stein
George Whitesides
Pierre Wiltzius

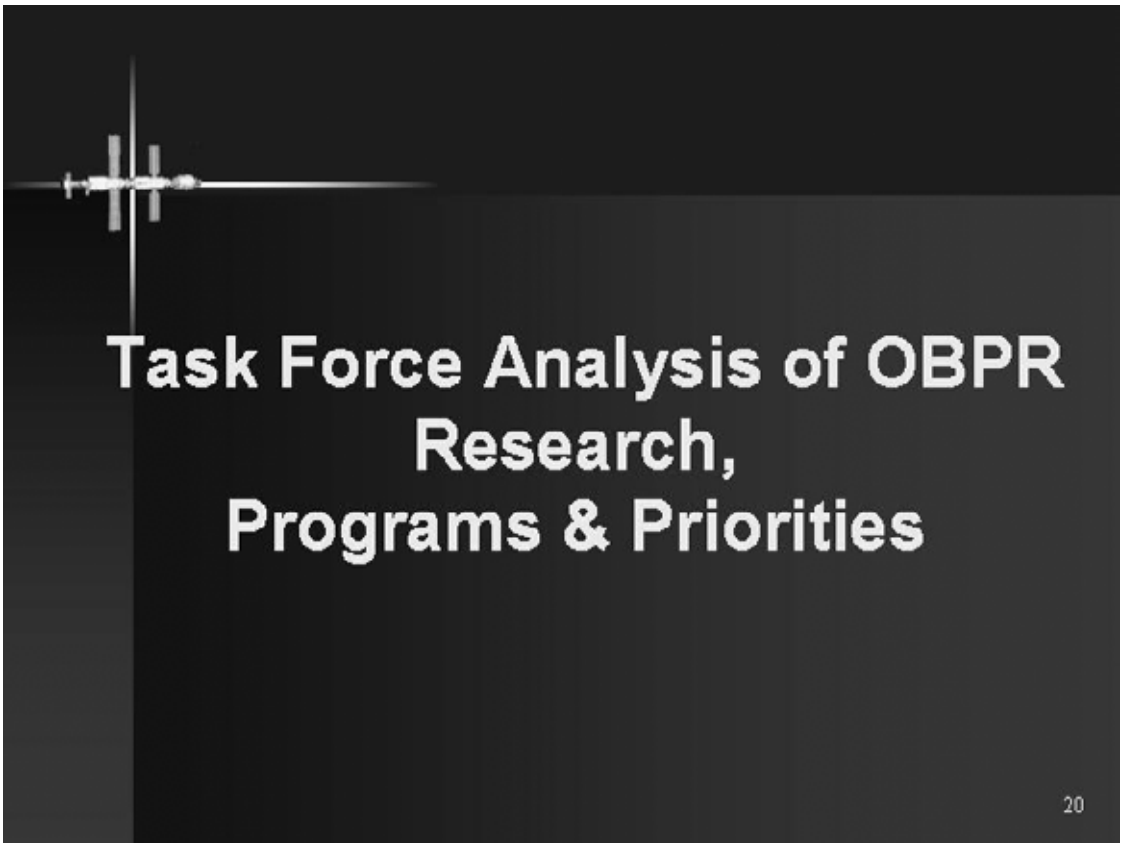
Engineering Research Enabling Exploration
Andreas Acrivos
Elaine Oran
Raymond Viskanta
George Whitesides
Pierre Wiltzius

Commercial Applied Sciences
Roger Beachy
Ray Bula
Noel Jones
Richard Roberts
George Whitesides
Pierre Wiltzius

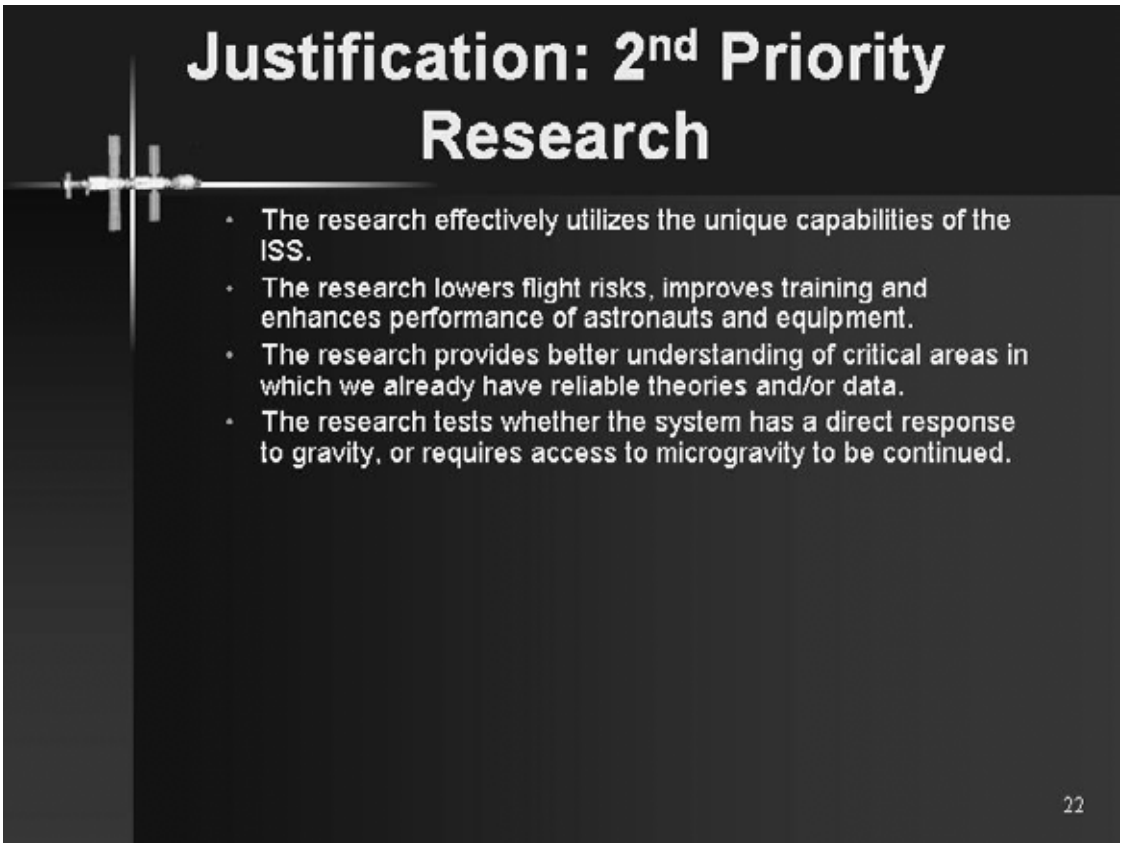
Commercial Engineering Research & Tech. Development
Ray Bula
Pat Morris
Richard Roberts
George Whitesides

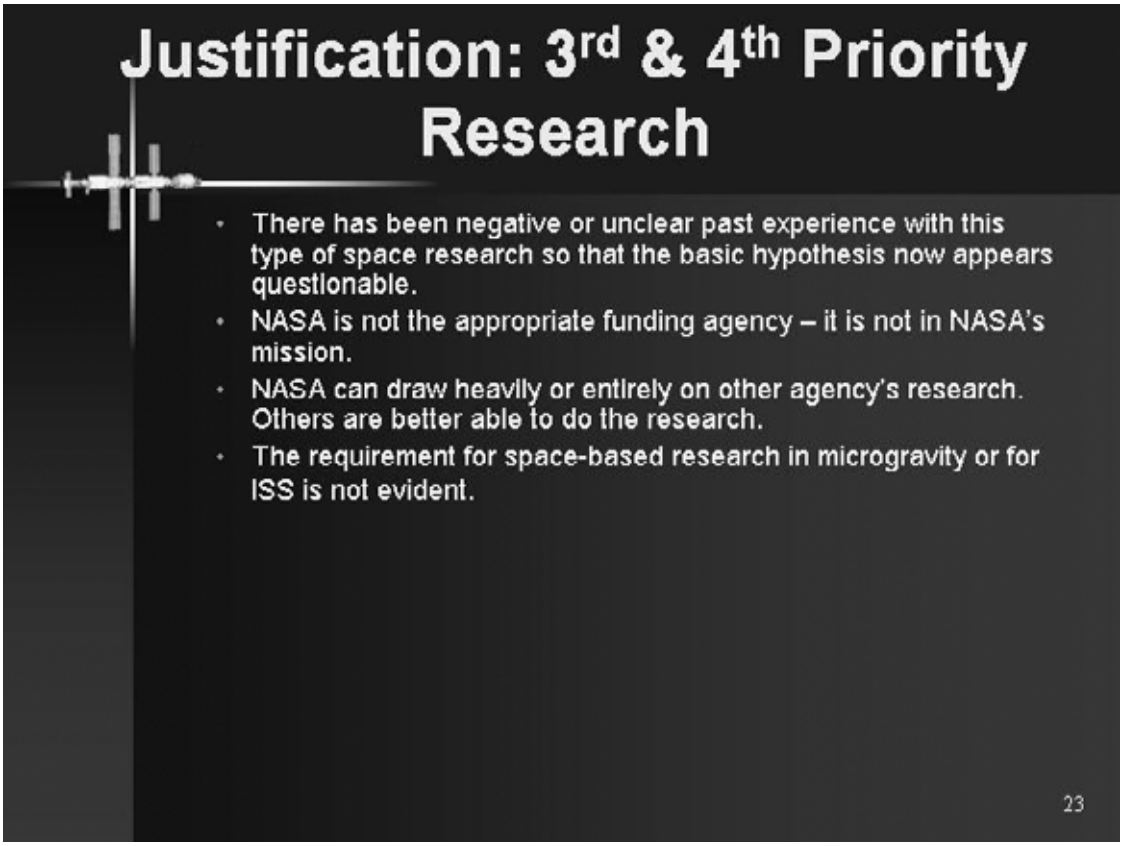
- **Laurie Zoloth (NAC member, ethicist) participated in all teams**

19

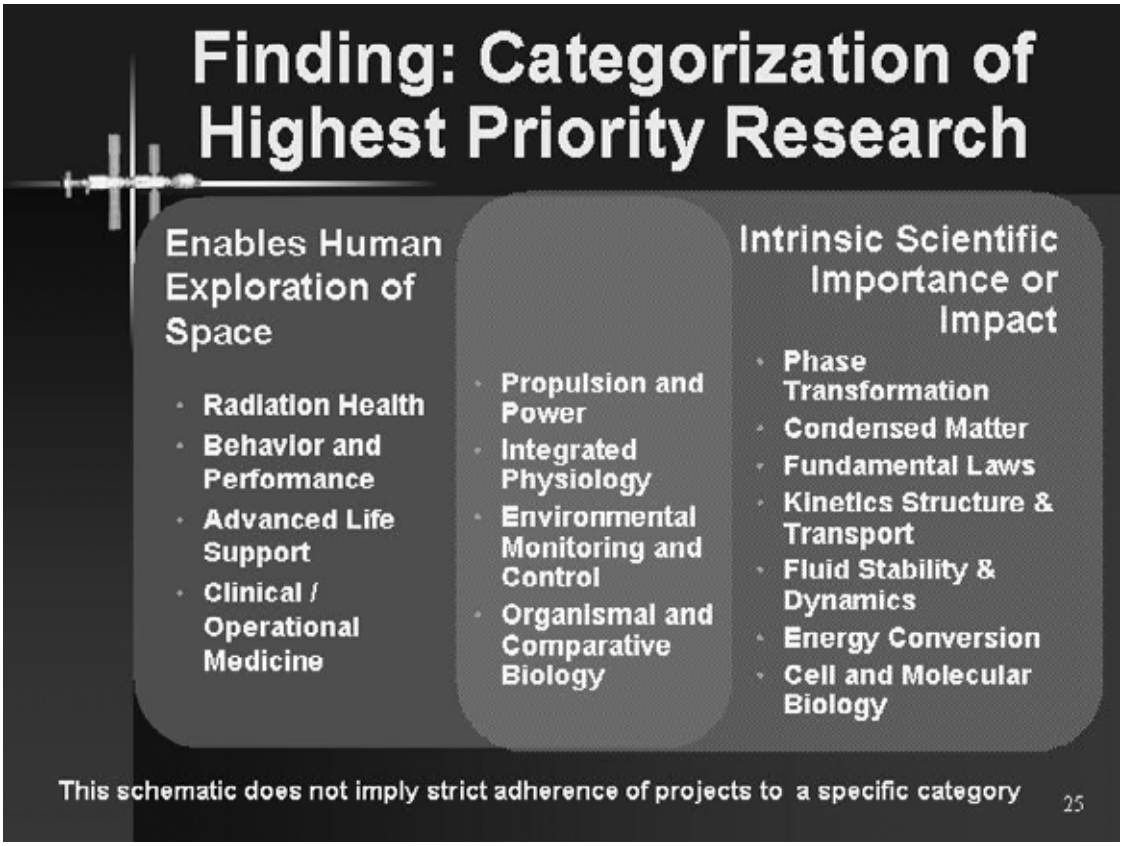


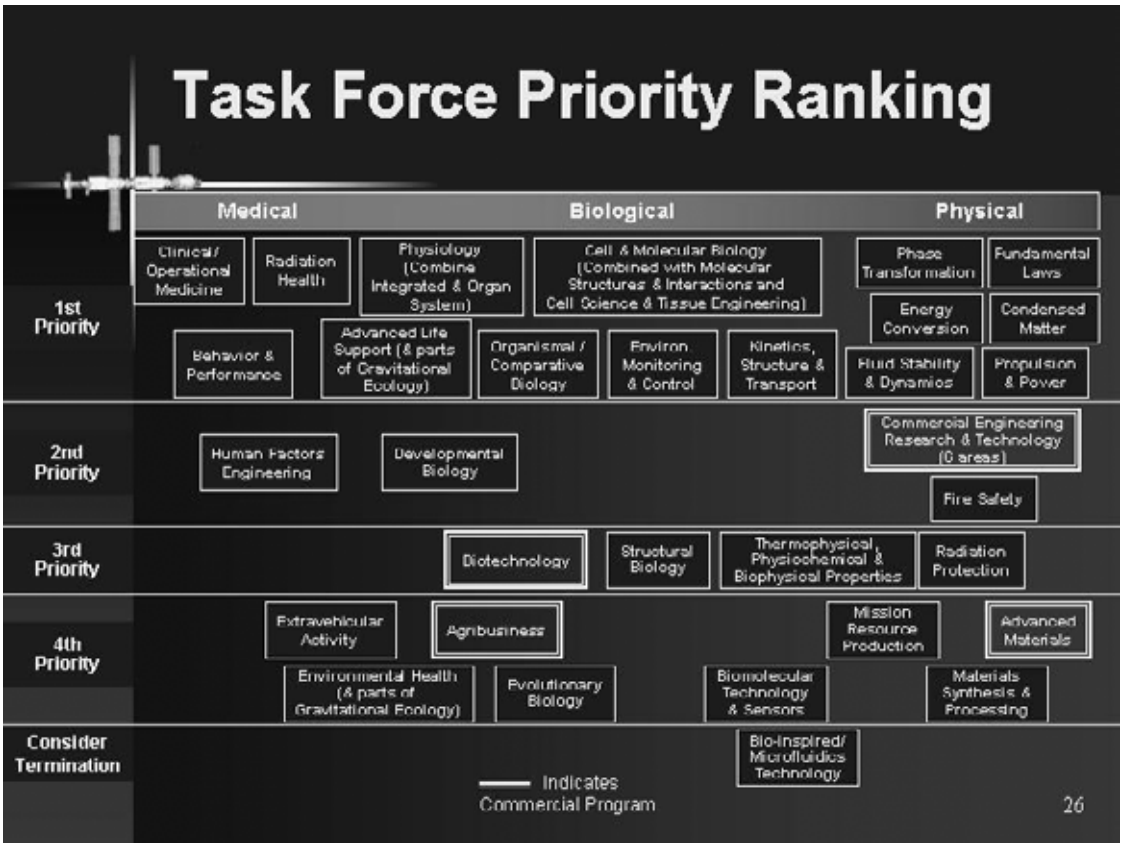

Justification: 1st Priority Research
The research is essential to enable future space exploration.
The research could reveal fundamental laws of nature.
The research is targeted toward systems with a known direct response to gravity.
The research is hypothesis based.
The research requires microgravity, human intervention, and long-term access to space.
If pertaining to countermeasure development, it is mechanism based.
There is potential for substantial increase in capability, efficiency or cost effectiveness as a result of this research.
The project enables the development of a new generation of research scholars by training graduate and postdoctoral students.
There is a high probability of developing technology and applications that will be useful on earth and in space.
There is an effective research community for quality ground- and flight- based research.
21

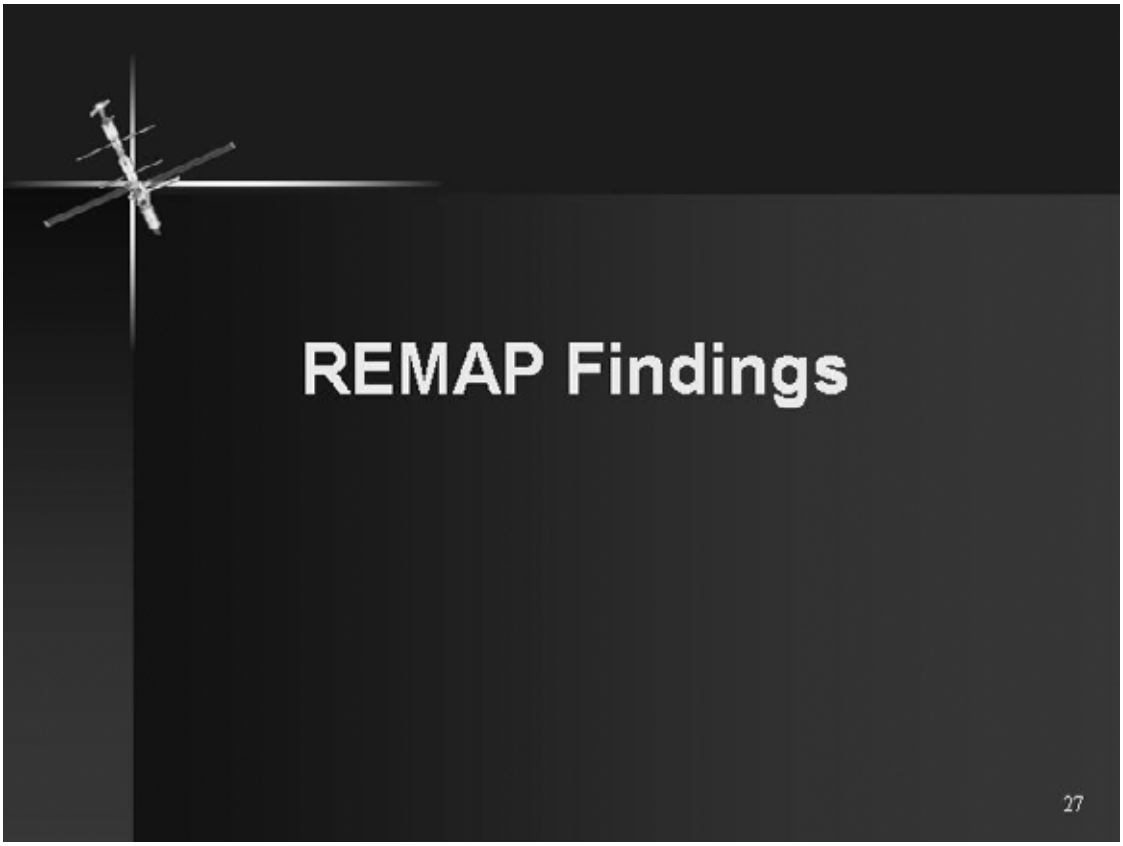

Justification: 2nd Priority Research
The research effectively utilizes the unique capabilities of the ISS.
The research lowers flight risks, improves training and enhances performance of astronauts and equipment.
The research provides better understanding of critical areas in which we already have reliable theories and/or data.
The research tests whether the system has a direct response to gravity, or requires access to microgravity to be continued.
22

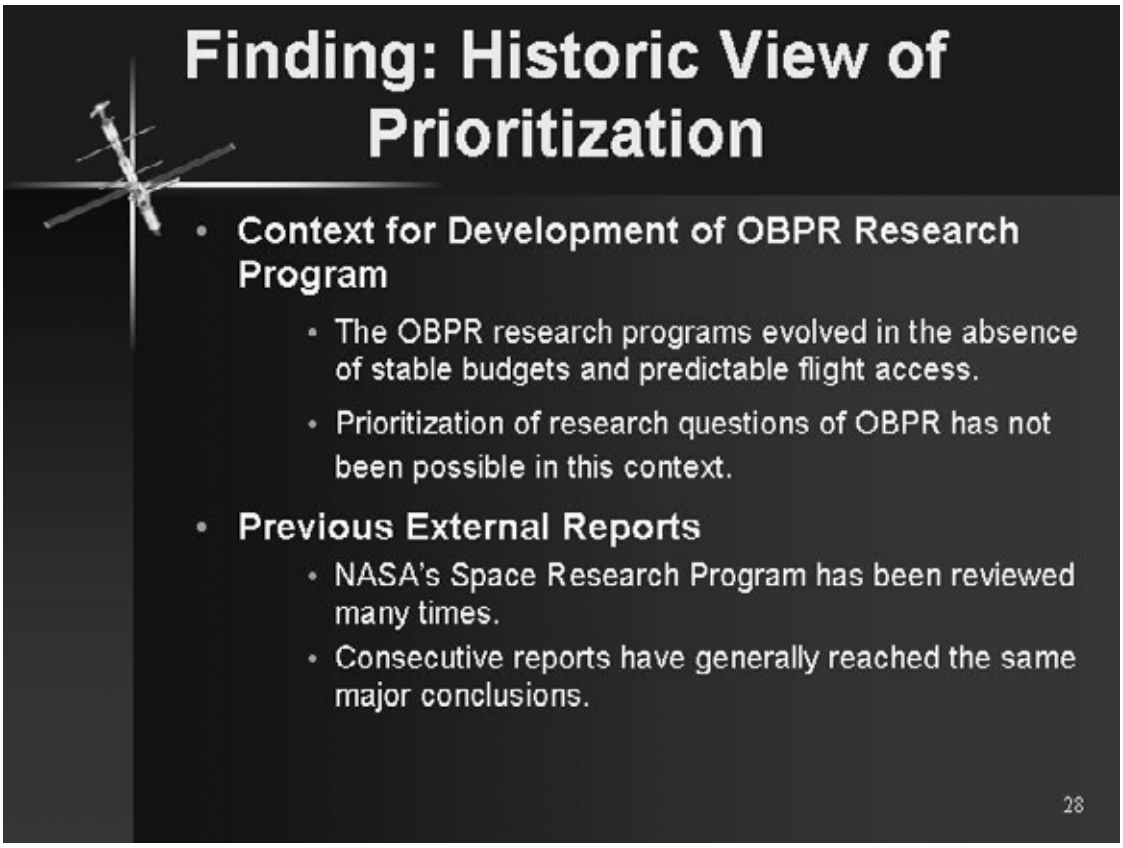

Justification: 3rd & 4th Priority Research
There has been negative or unclear past experience with this type of space research so that the basic hypothesis now appears questionable.
NASA is not the appropriate funding agency – it is not in NASA's mission.
NASA can draw heavily or entirely on other agency's research. Others are better able to do the research.
The requirement for space-based research in microgravity or for ISS is not evident.
23


OVERALL Finding on Research Priorities for ISS
Research of highest priority fell into two broad categories:
Enables Human Exploration of Space
Intrinsic Scientific Merit
These two categories are consonant with the historical goals of OBPR.
•Some research emphasizes human exploration of space.
•Some research emphasizes intrinsic scientific importance and impact.
•Some research overlaps both goals.
Prioritization between these categories is a NASA programmatic decision.
24

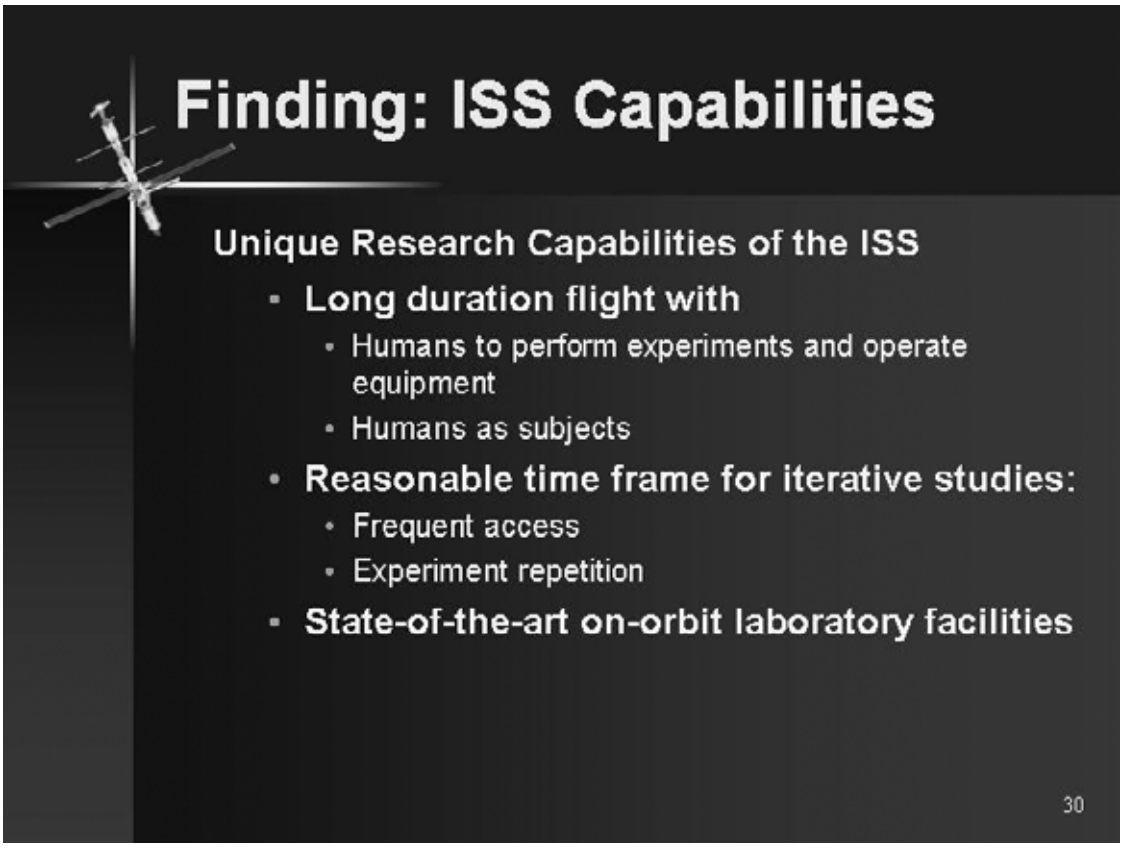

Finding: Categorization of Highest Priority Research
Enables Human Exploration of Space
Radiation Health
Behavior and Performance
Advanced Life Support
Clinical / Operational Medicine
Propulsion and Power
Integrated Physiology
Environmental Monitoring and Control
Organismal and Comparative Biology
Intrinsic Scientific Importance or Impact
Phase Transformation
Condensed Matter
Fundamental Laws
Kinetics Structure & Transport
Fluid Stability & Dynamics
Energy Conversion
Cell and Molecular Biology
This schematic does not imply strict adherence of projects to a specific category
25


Task Force Priority Ranking
Medical
Biological
Physical
1st Priority
Clinical/ Operational Medicine
Radiation Health
Physiology (Combine Integrated & Organ System)
Cell & Molecular Biology (Combined with Molecular Structures & Interactions and Cell Science & Tissue Engineering)
Phase Transformation
Fundamental Laws
Energy Conversion
Condensed Matter
Behavior & Performance
Advanced Life Support (& parts of Gravitational Ecology)
Organismal / Comparative Biology
Environ Monitoring & Control
Kinetics, Structure & Transport
Fluid Stability & Dynamics
Propulsion & Power
2nd Priority
Human Factors Engineering
Developmental Biology
Commercial Engineering Research & Technology (0 areas)
Fire Safety
3rd Priority
Biotechnology
Structural Biology
Thermophysical, Physiochemical & Biophysical Properties
Radiation Protection
4th Priority
Extravehicular Activity
Agribusiness
Mission Resource Production
Advanced Materials
Environmental Health (& parts of Gravitational Ecology)
Evolutionary Biology
Biomolecular Technology & Sensors
Materials Synthesis & Processing
Consider Termination
Bio-Inspired/ Microfluidics Technology
Indicates Commercial Program
26


REMAP Findings
27


Finding: Historic View of Prioritization
Context for Development of OBPR Research Program
The OBPR research programs evolved in the absence of stable budgets and predictable flight access.
Prioritization of research questions of OBPR has not been possible in this context.
Previous External Reports
NASA's Space Research Program has been reviewed many times.
Consecutive reports have generally reached the same major conclusions.
28


Finding: OBPR Research Platforms
• The OBPR research program includes elements that:
➢ Require ISS
➢ ISS is optimal but not necessary
➢ Can be addressed using the Shuttle
➢ Can be addressed using free flyers
➢ Can be addressed in ground based research
29


Finding: ISS Capabilities
Unique Research Capabilities of the ISS
• Long duration flight with
• Humans to perform experiments and operate equipment
• Humans as subjects
• Reasonable time frame for iterative studies:
• Frequent access
• Experiment repetition
• State-of-the-art on-orbit laboratory facilities
30

Finding: ISS Biological Research Needs a Centrifuge

- The Task Force encourages expedited development of the centrifuge with appropriate external review and guidance to insure timely deployment.
- The ISS centrifuge serves two essential research functions in the biological sciences:
  - it provides a rigorous in-flight control condition with a centrifugal field where gravity-driven forces can act, and
  - it produces a variable gravity field to identify threshold loading conditions that might facilitate biological processes.
- Engineering aspects of the centrifuge appear to be largely resolved.
- Current engineering analysis indicates that the centrifuge will not violate ISS microgravity requirements.
- If necessary, centrifuge use could be scheduled to eliminate (currently unforseen) interactions with other experiments.

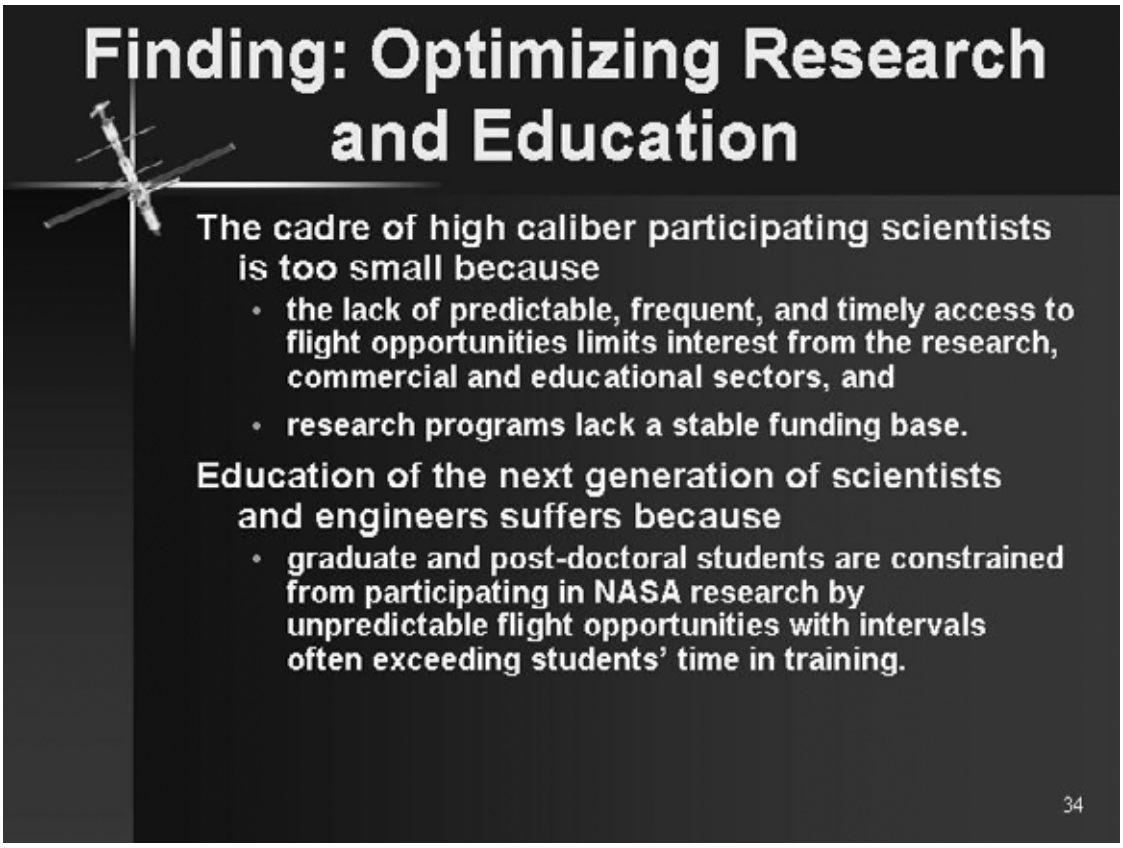
31

Finding: OBPR Organization

- OBPR organization, program structure, and solicitation mechanisms:
  - are based on research discipline,
  - lack a strategic approach,
  - are not optimal for identification and implementation of high priority/high impact research.
- Strategic approach may identify:
  - Expected outcomes
  - Roadmap to achieving goals
  - Most effective organization to achieve goals
  - Appropriate mechanics for solicitations
  - Appropriate modes for research (e.g., team approach or single investigator)
  - Need for sunset condition on research projects

32


Finding: Need for Commercial Research
Public Law 105-330 establishes as public policy the commercial use of the ISS, and NASA's role in facilitating this use.
The Task Force used the research merit criteria developed.
Evaluation of the commercial programs required additional criteria appropriate for commercial activities. These include:
private sector interest and investment,
national economic priorities, and contributions to economic growth.
33

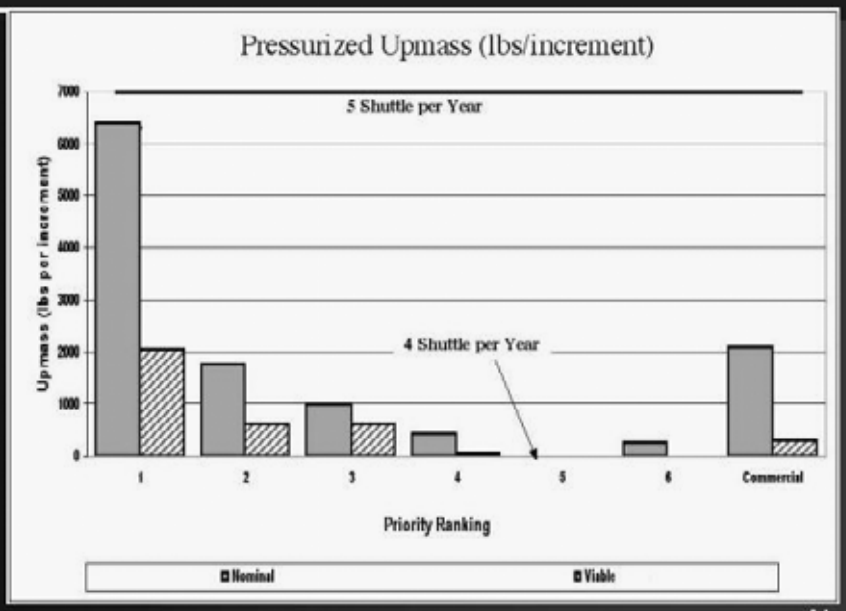

Finding: Optimizing Research and Education
The cadre of high caliber participating scientists is too small because
the lack of predictable, frequent, and timely access to flight opportunities limits interest from the research, commercial and educational sectors, and
research programs lack a stable funding base.
Education of the next generation of scientists and engineers suffers because
graduate and post-doctoral students are constrained from participating in NASA research by unpredictable flight opportunities with intervals often exceeding students' time in training.
34

OBPR Finding: Preliminary Implementation Analysis of 1st and 2nd Priority Research

- Most of the REMAP research priority findings were established at REMAP Meeting #2.
- OBPR preliminary ISS implementation analysis was conducted following meeting #2 and was based on these interim Task Force research priority findings.

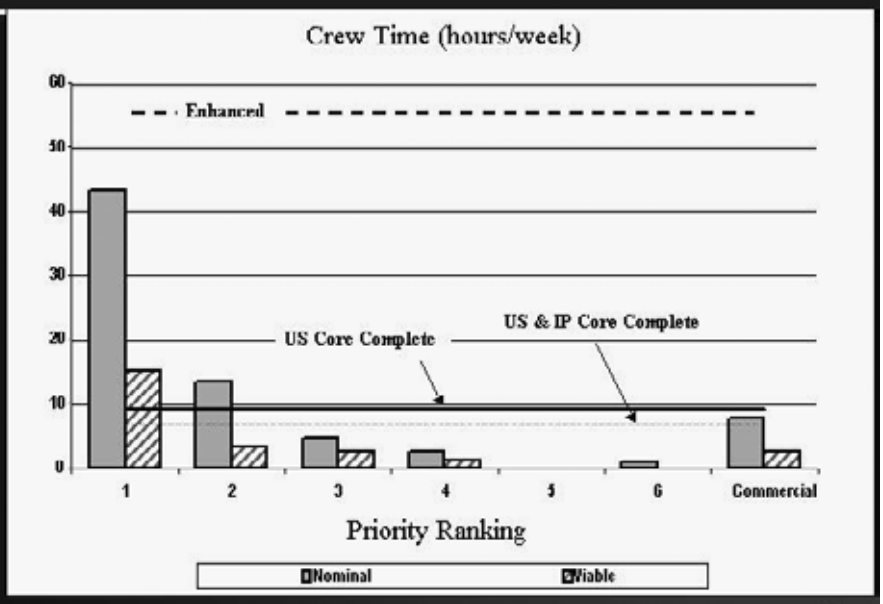
35

Pressurized Upmass Requirements by Research Priority



36

Crew Time Requirements by Research Priority



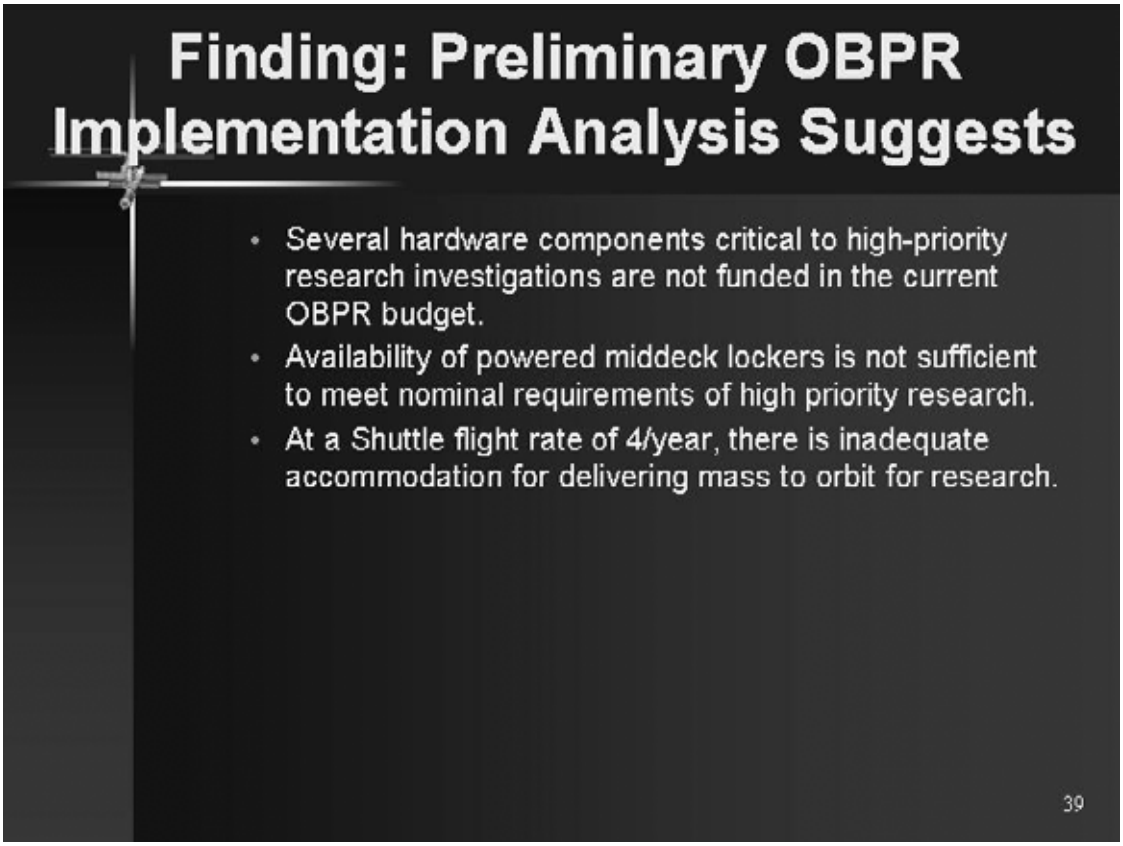
37

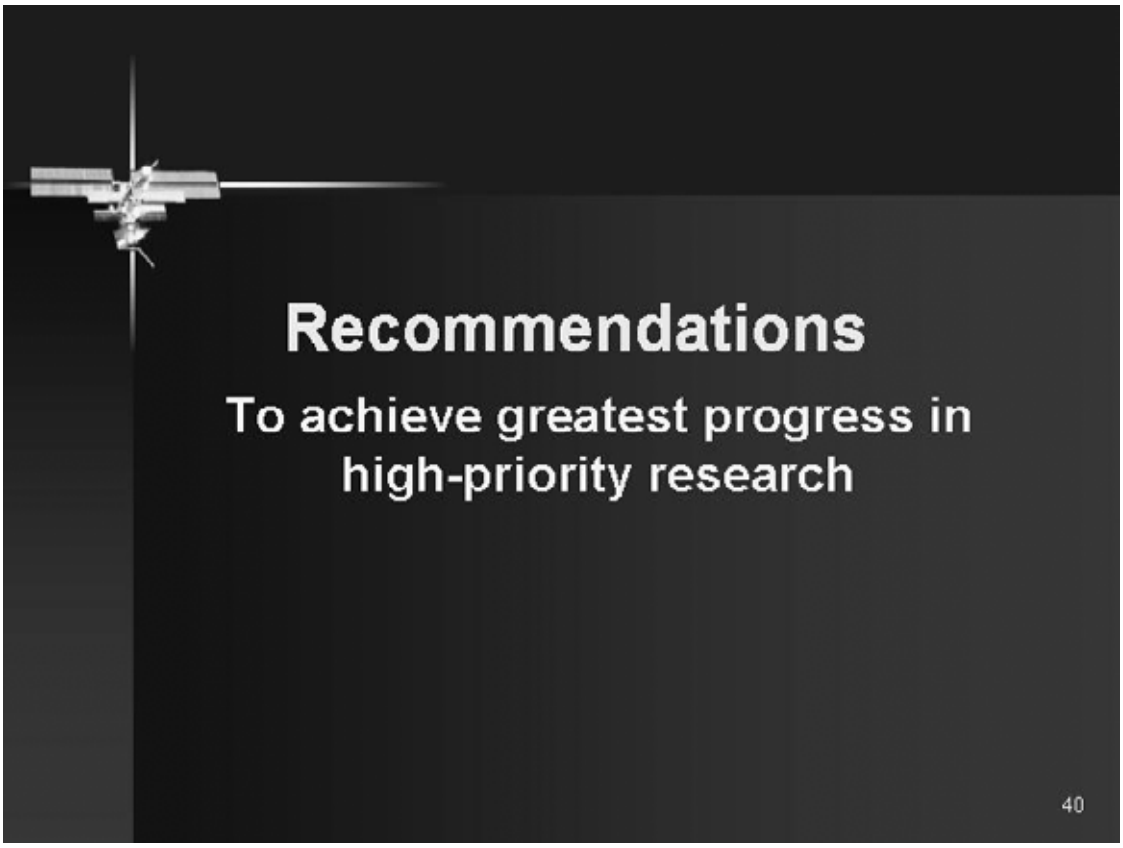
Finding: Preliminary OBPR Implementation Analysis Suggests

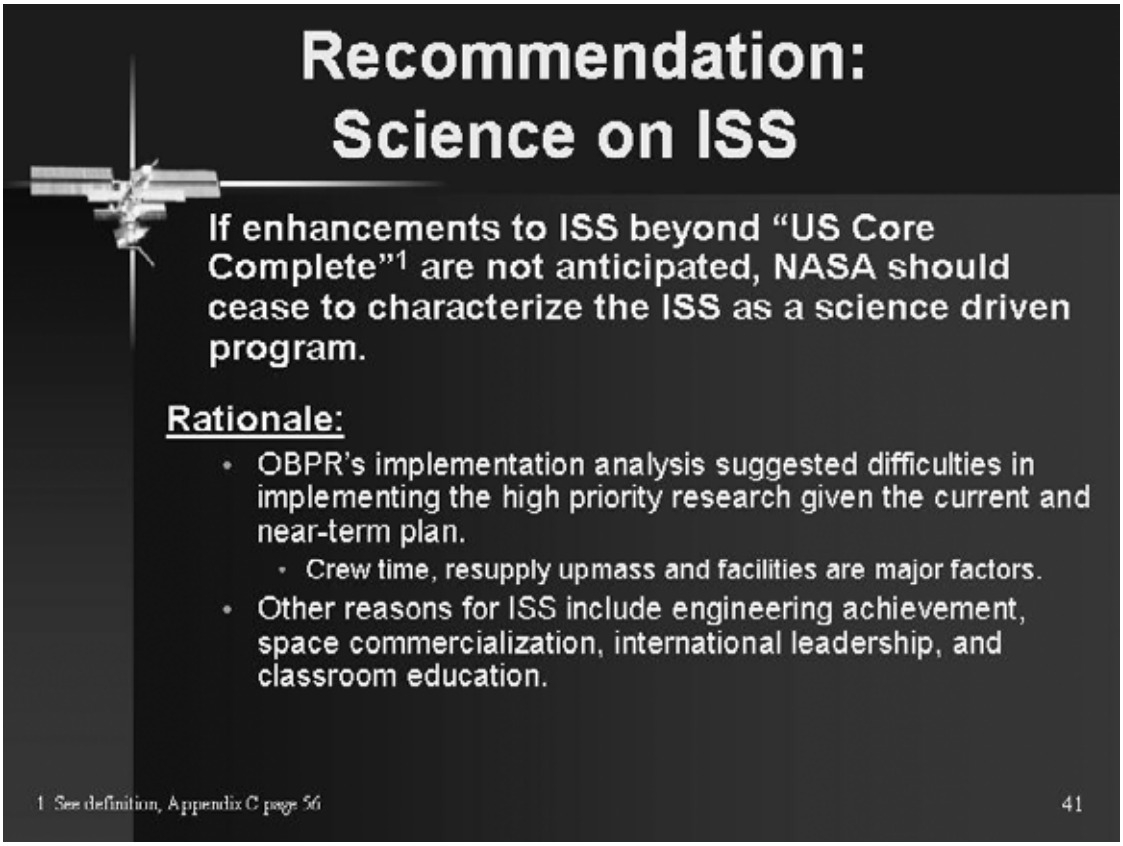
At US Core Complete and at US+IP Core Complete capability to do high priority research is limited.

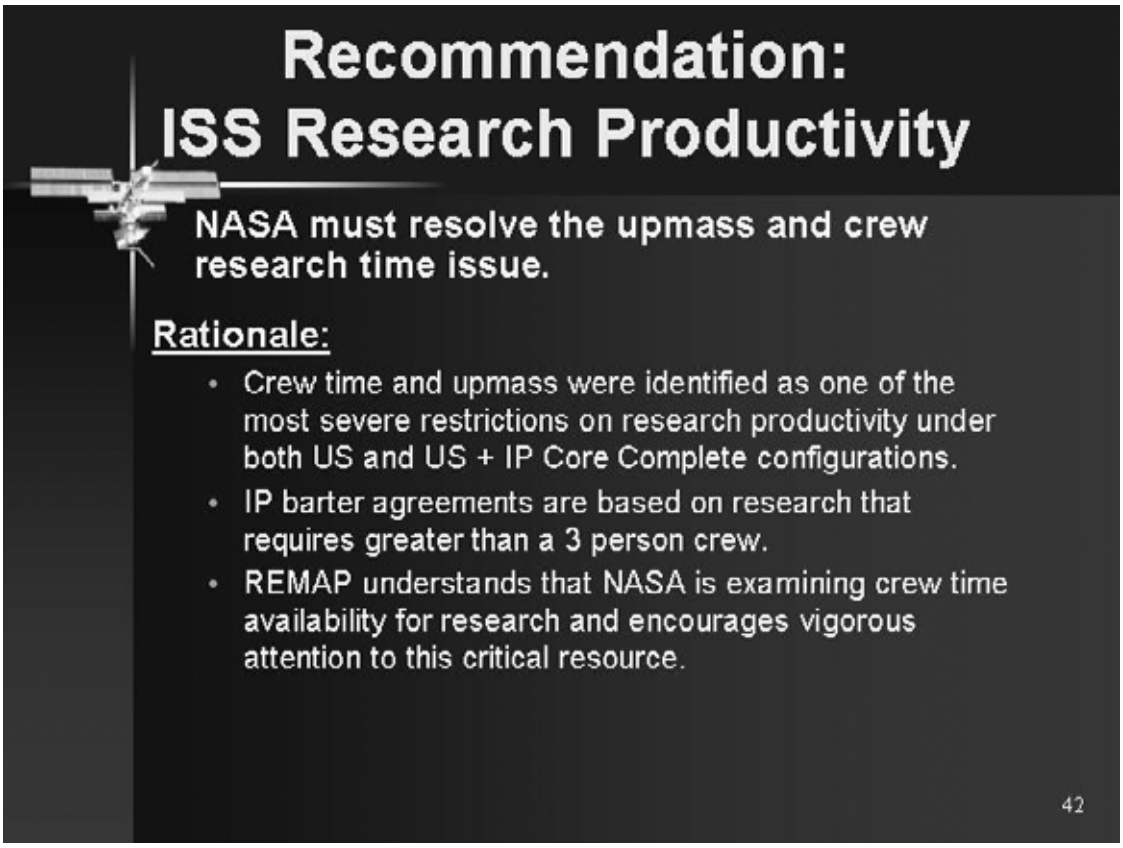
- Crew time and upmass places constraints on the amount of high priority research that can be addressed.
- Commitments to International Partners exacerbate the problems of adequate crew time.
- Some OBPR research of scientific and/or commercial importance can be accommodated on platforms other than ISS.

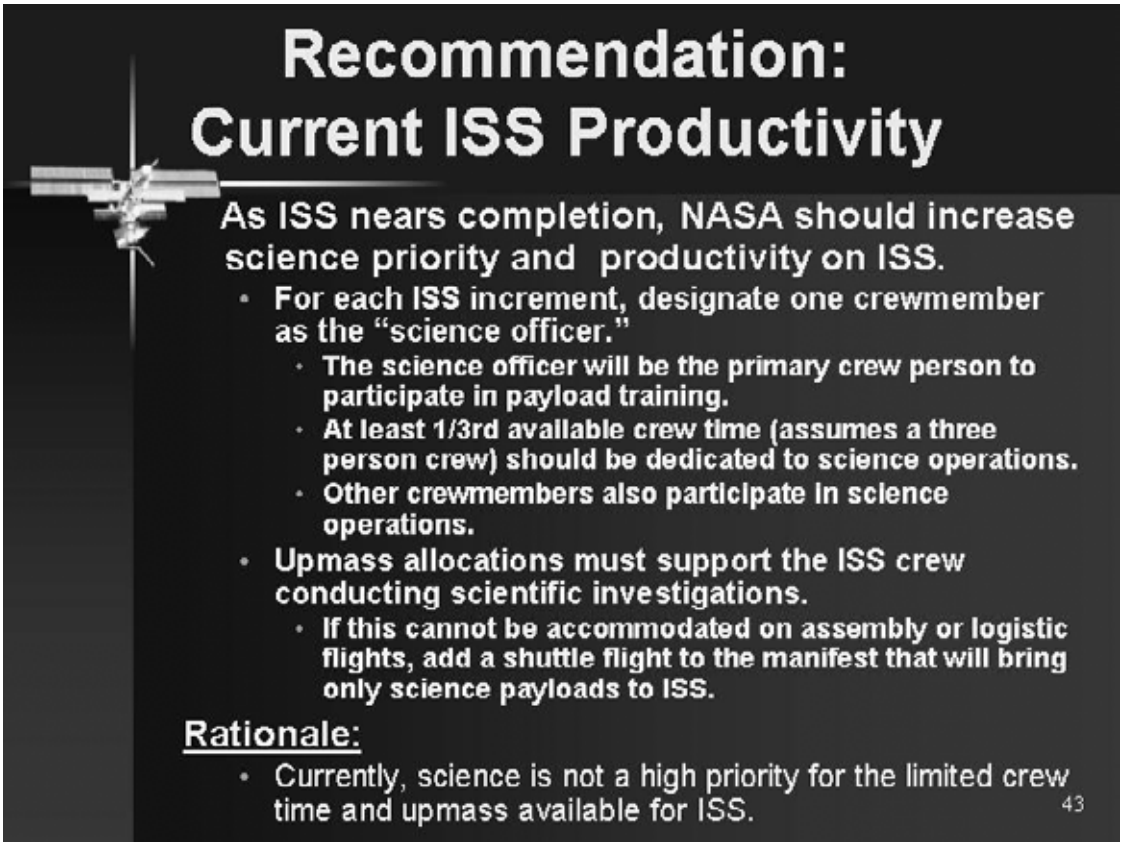
38


Finding: Preliminary OBPR Implementation Analysis Suggests
• Several hardware components critical to high-priority research investigations are not funded in the current OBPR budget.
• Availability of powered middeck lockers is not sufficient to meet nominal requirements of high priority research.
• At a Shuttle flight rate of 4/year, there is inadequate accommodation for delivering mass to orbit for research.
39

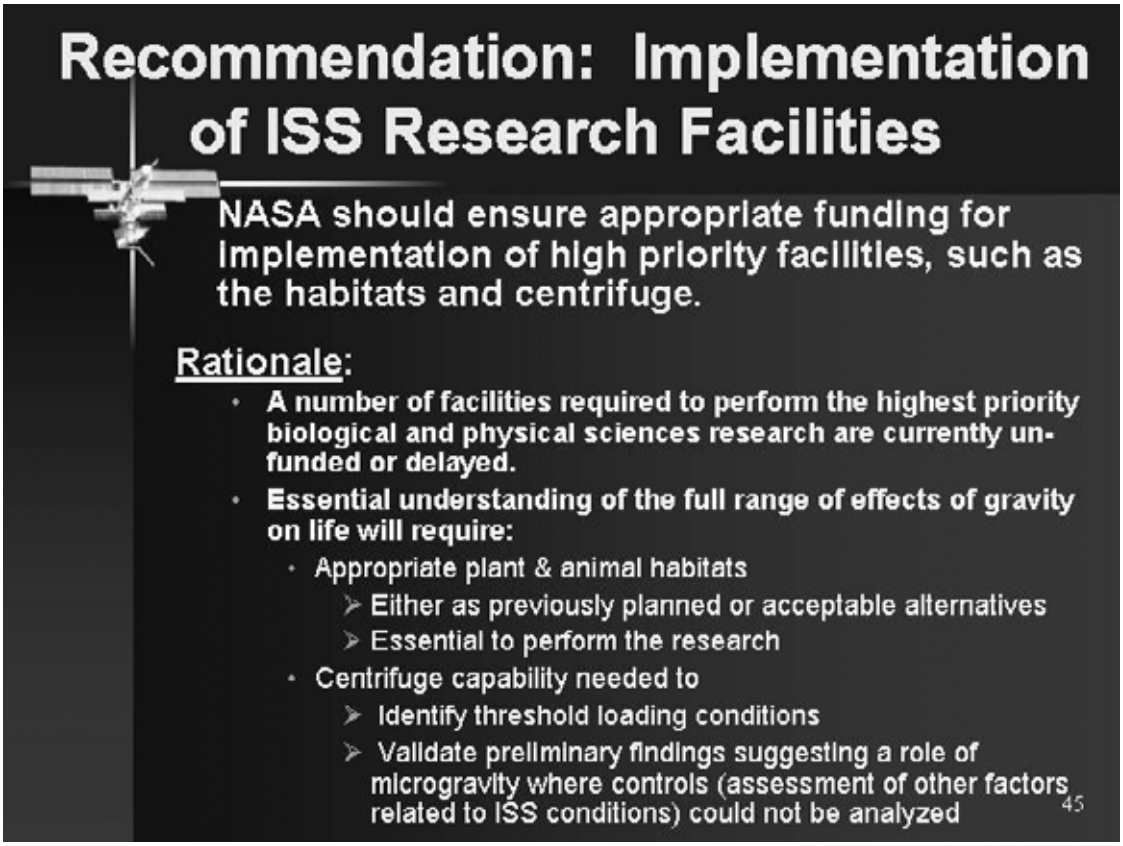

Recommendations
To achieve greatest progress in high-priority research
40


Recommendation:
Science on ISS
If enhancements to ISS beyond "US Core Complete"[1] are not anticipated, NASA should cease to characterize the ISS as a science driven program.
Rationale:
• OBPR's implementation analysis suggested difficulties in implementing the high priority research given the current and near-term plan.
◦ Crew time, resupply upmass and facilities are major factors.
• Other reasons for ISS include engineering achievement, space commercialization, international leadership, and classroom education.
1 See definition, Appendix C page 56
41

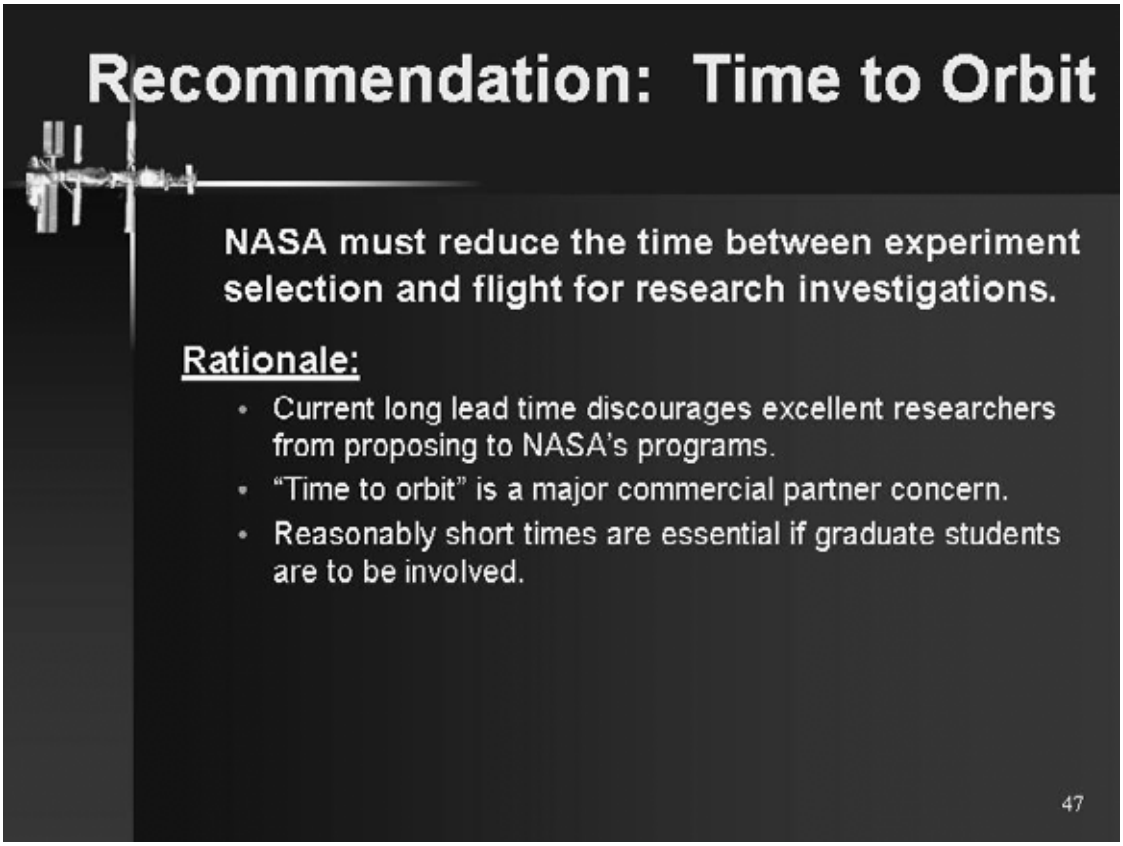

Recommendation:
ISS Research Productivity
NASA must resolve the upmass and crew research time issue.
Rationale:
• Crew time and upmass were identified as one of the most severe restrictions on research productivity under both US and US + IP Core Complete configurations.
• IP barter agreements are based on research that requires greater than a 3 person crew.
• REMAP understands that NASA is examining crew time availability for research and encourages vigorous attention to this critical resource.
42

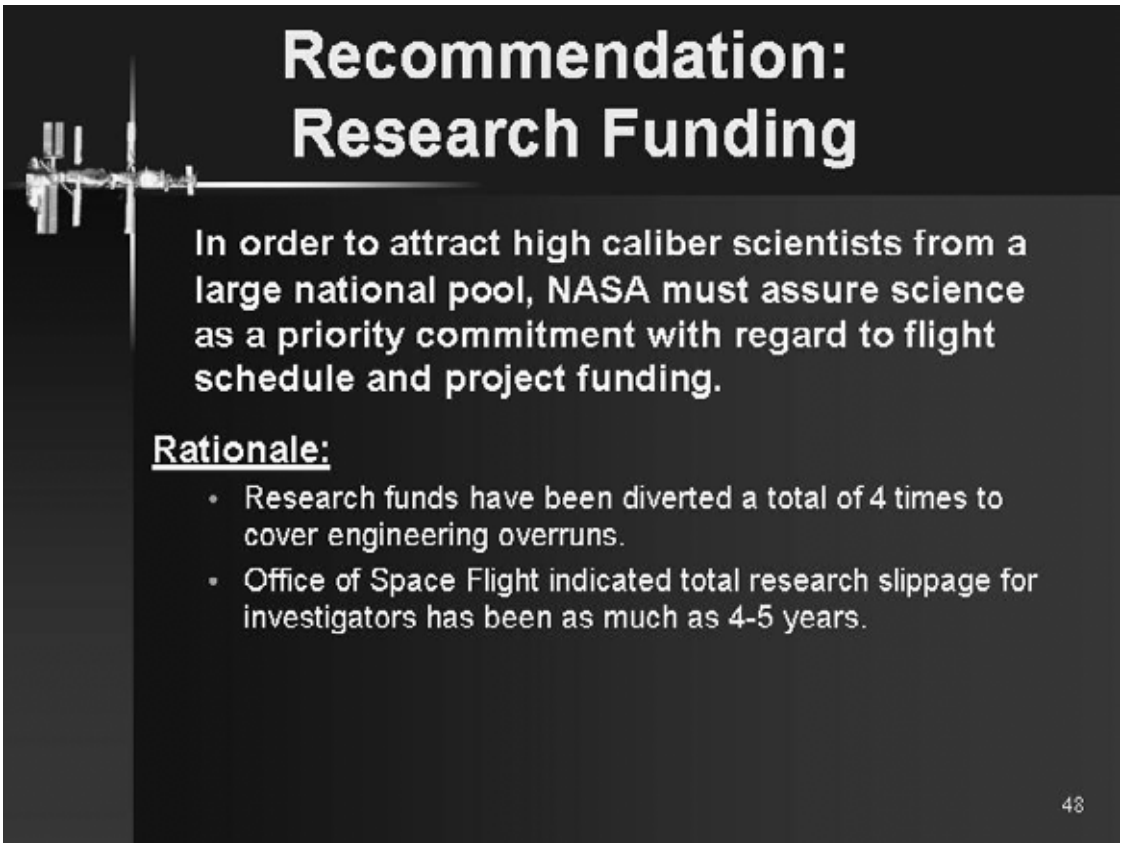

Recommendation:
Current ISS Productivity
As ISS nears completion, NASA should increase science priority and productivity on ISS.
For each ISS increment, designate one crewmember as the "science officer."
The science officer will be the primary crew person to participate in payload training.
At least 1/3rd available crew time (assumes a three person crew) should be dedicated to science operations.
Other crewmembers also participate in science operations.
Upmass allocations must support the ISS crew conducting scientific investigations.
If this cannot be accommodated on assembly or logistic flights, add a shuttle flight to the manifest that will bring only science payloads to ISS.
Rationale:
Currently, science is not a high priority for the limited crew time and upmass available for ISS.
43


Recommendation:
Basic Research
OBPR should include, in its high-priority research portfolio, outstanding basic scientific research programs that address important questions in the physical and biological sciences, and which require long-term experiments on the ISS, based on their intrinsic scientific value.
Rationale:
OBPR's research portfolio must be built around the most important scientific problems relevant to the NASA mission on the ISS, rather than covering representative sub-fields of science.
44

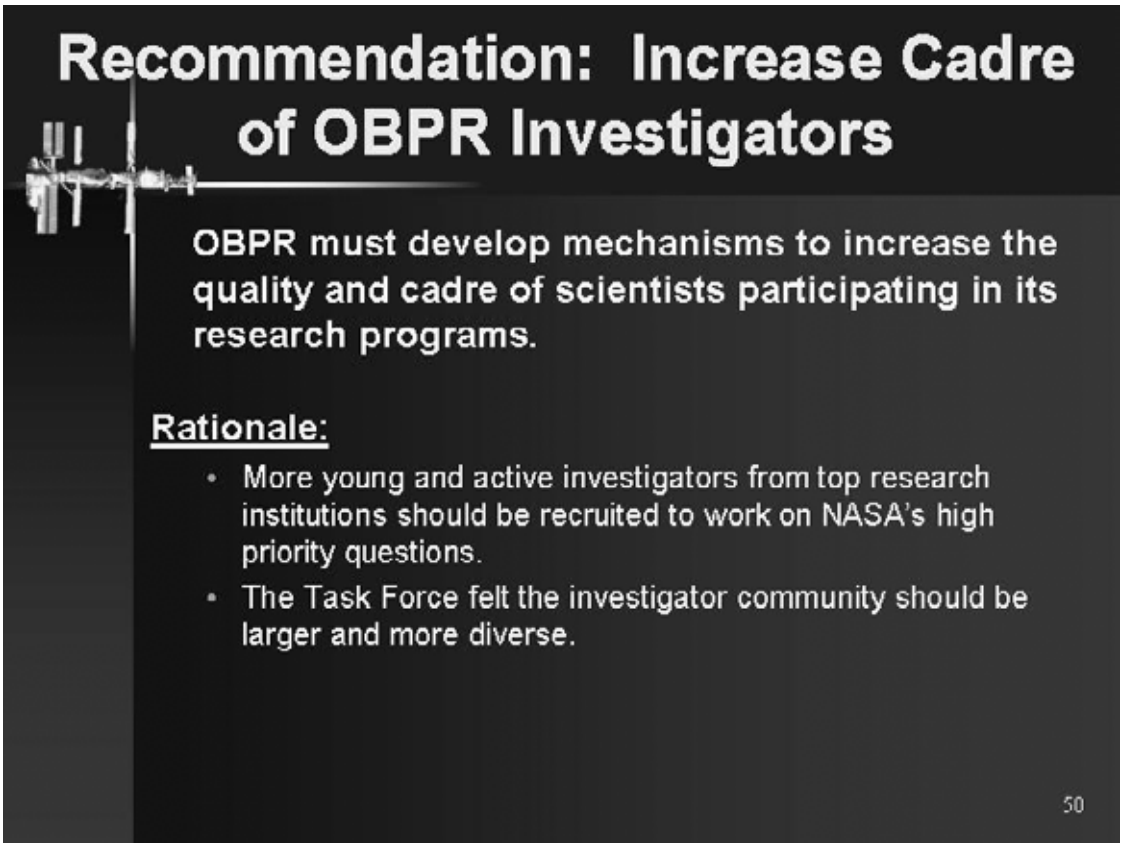

Recommendation: Implementation of ISS Research Facilities
NASA should ensure appropriate funding for implementation of high priority facilities, such as the habitats and centrifuge.
Rationale:
A number of facilities required to perform the highest priority biological and physical sciences research are currently un-funded or delayed.
Essential understanding of the full range of effects of gravity on life will require:
Appropriate plant & animal habitats
Either as previously planned or acceptable alternatives
Essential to perform the research
Centrifuge capability needed to
Identify threshold loading conditions
Validate preliminary findings suggesting a role of microgravity where controls (assessment of other factors related to ISS conditions) could not be analyzed
45


Recommendation: Fully Utilize Available Options for Space Research
NASA should consider additional Shuttle science/commercial flight opportunities.
Investigate dedicated science and/or commercial flights on a regular basis.
Guarantee flight opportunities
Guarantee routine, repetitive access to space
Investigate the possibility of auctioning rack space to gauge true market interest.
Rationale:
Many science priorities do not need long duration in space.
Many science priorities do need repetitive, routine access to space.
NASA funding may impact market interest.
Use of non-NASA funds to purchase a flight opportunity can be used as another indication of the value of the proposed space research.
46

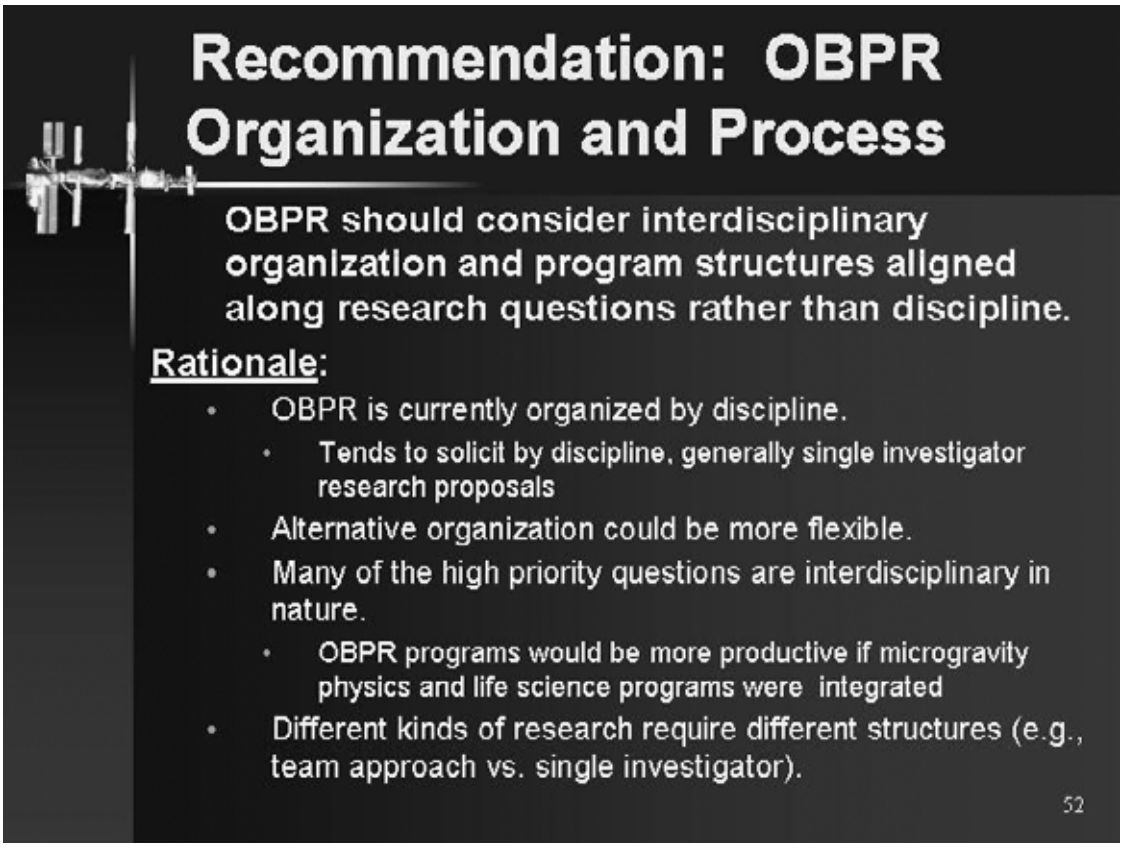

Recommendation: Time to Orbit
NASA must reduce the time between experiment selection and flight for research investigations.
Rationale:
• Current long lead time discourages excellent researchers from proposing to NASA's programs.
• "Time to orbit" is a major commercial partner concern.
• Reasonably short times are essential if graduate students are to be involved.
47


Recommendation: Research Funding
In order to attract high caliber scientists from a large national pool, NASA must assure science as a priority commitment with regard to flight schedule and project funding.
Rationale:
• Research funds have been diverted a total of 4 times to cover engineering overruns.
• Office of Space Flight indicated total research slippage for investigators has been as much as 4-5 years.
48

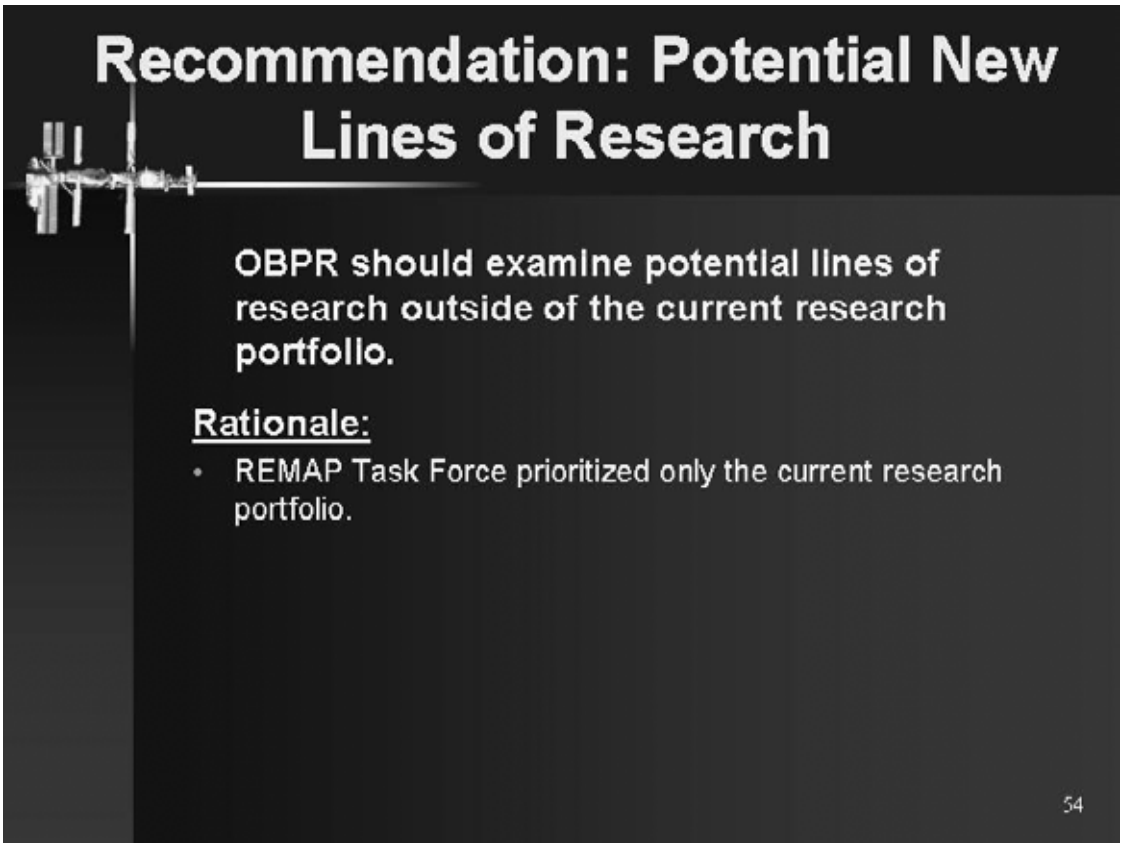

Recommendation: Methods for Research Solicitation
OBPR should consider alternative methods for research solicitation and recruiting of key performers.
Rationale:
Solutions for OBPR's goal-oriented, need-driven, research problems may be facilitated by alternative methods of solicitation and recruiting.
Project selection by peer review
A consensus based approach
Works best for individual PI science programs
Works best for broad focus, science community driven
DARPA-style program management
Can open new areas
Serves to build communities
Can support multi-investigator projects
Works best for goal-oriented research
49

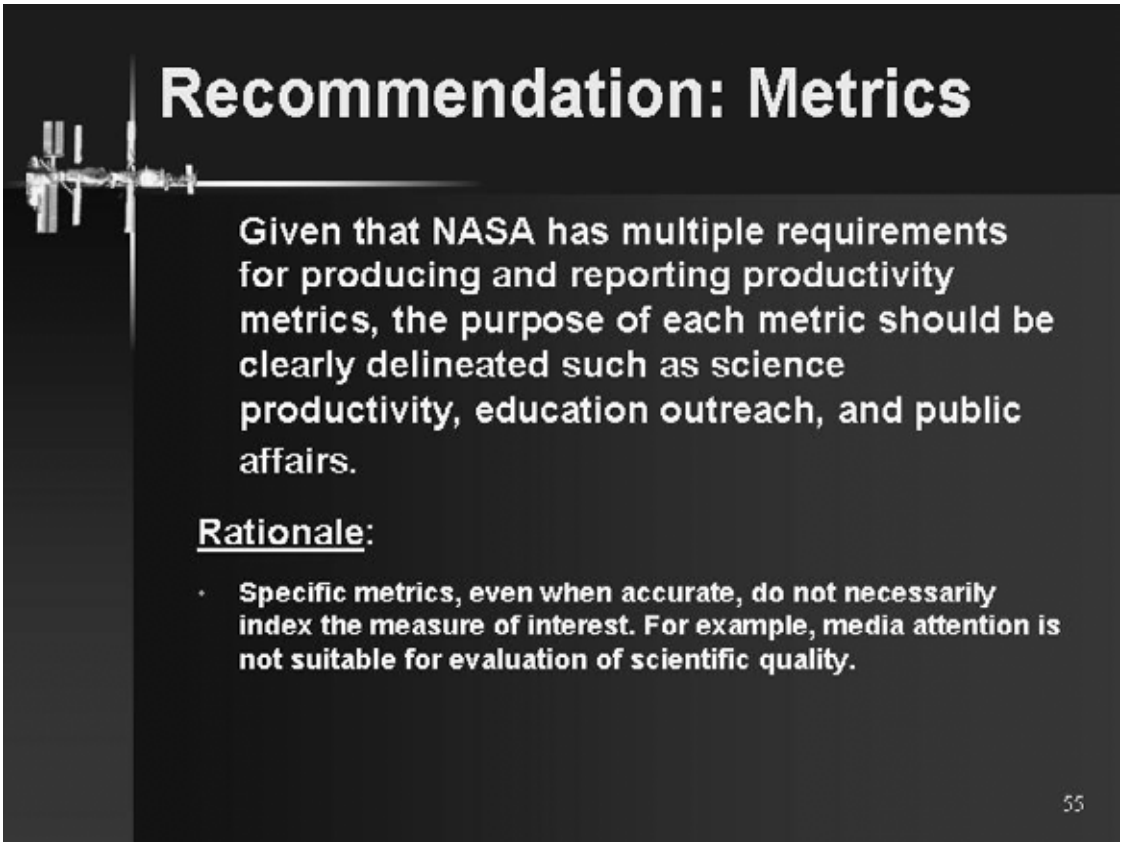

Recommendation: Increase Cadre of OBPR Investigators
OBPR must develop mechanisms to increase the quality and cadre of scientists participating in its research programs.
Rationale:
More young and active investigators from top research institutions should be recruited to work on NASA's high priority questions.
The Task Force felt the investigator community should be larger and more diverse.
50

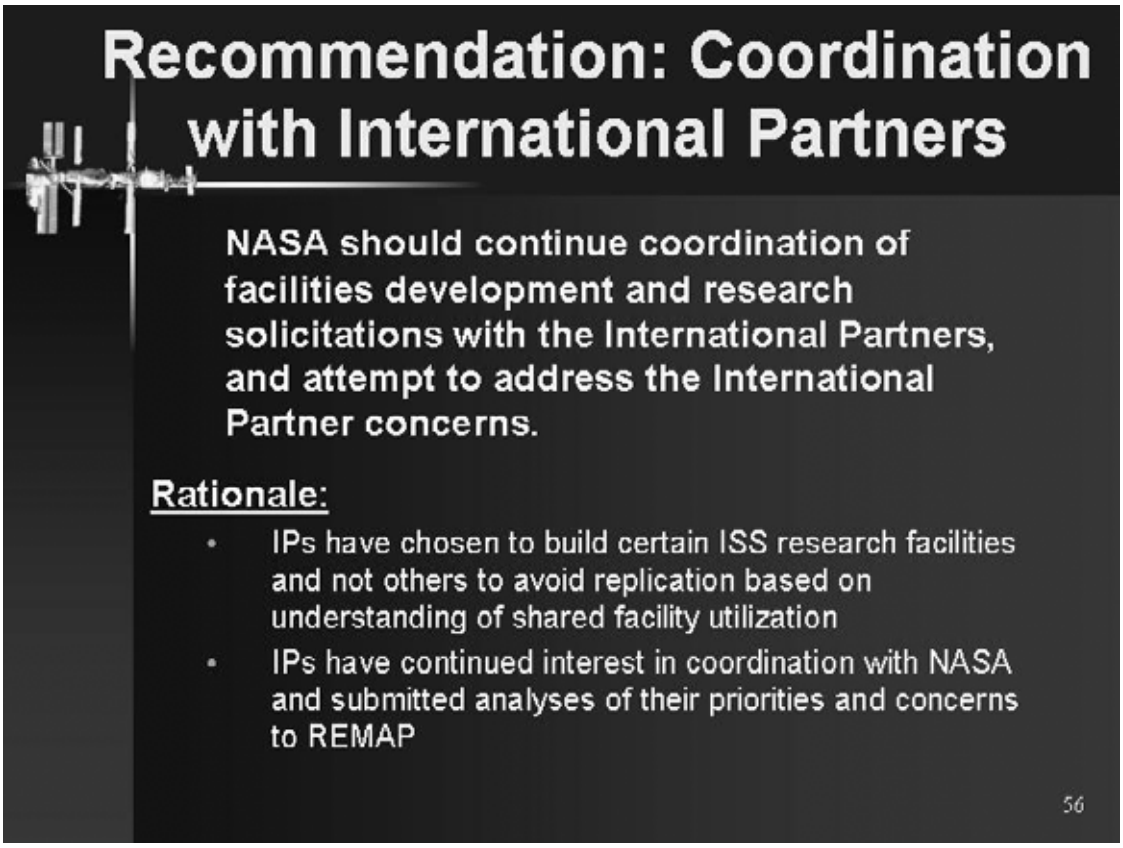

Recommendation:
Science Leadership
OBPR scientists should ensure the development of a visionary strategic research program that is focused on the problems whose solutions will further the NASA mission.
Rationale:
• Development of a strategic, goal oriented program will enable selection of the best research to facilitate space exploration and fundamental science.
51

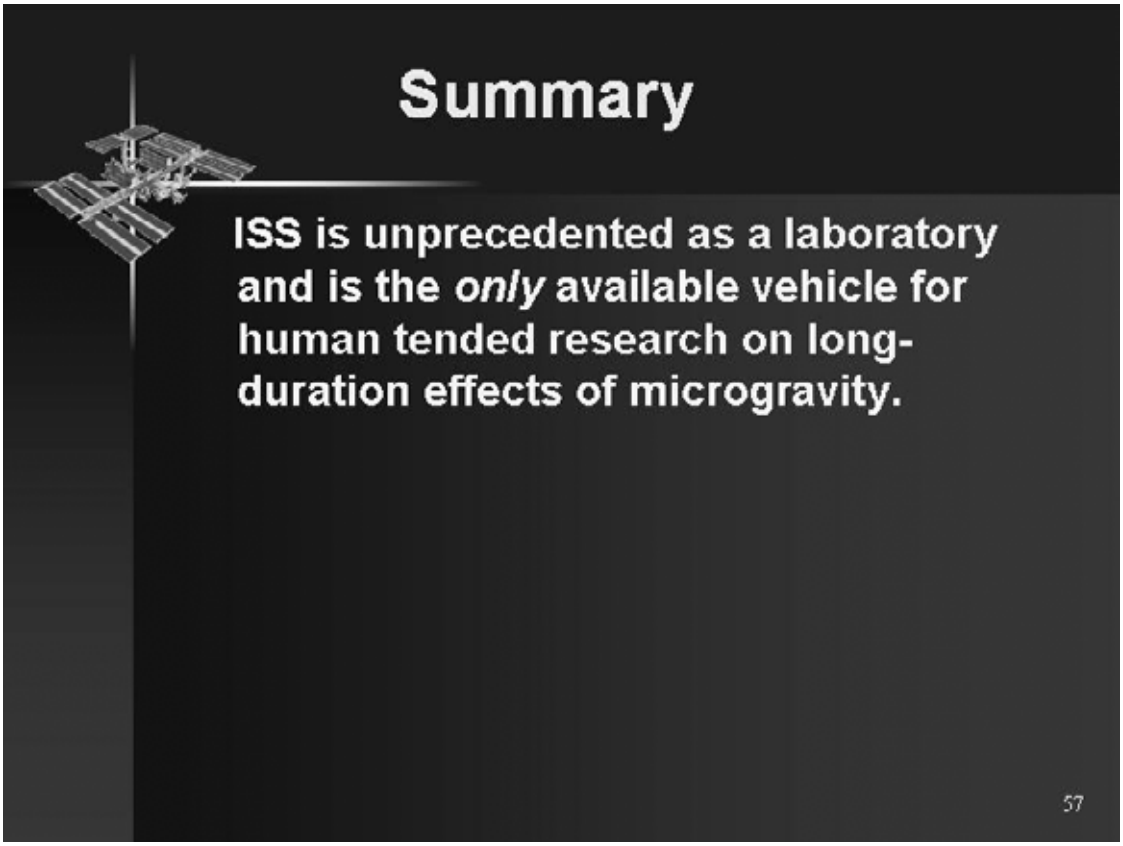

Recommendation: OBPR Organization and Process
OBPR should consider interdisciplinary organization and program structures aligned along research questions rather than discipline.
Rationale:
• OBPR is currently organized by discipline.
• Tends to solicit by discipline, generally single investigator research proposals
• Alternative organization could be more flexible.
• Many of the high priority questions are interdisciplinary in nature.
• OBPR programs would be more productive if microgravity physics and life science programs were integrated
• Different kinds of research require different structures (e.g., team approach vs. single investigator).
52


Recommendation:
Coordinating Research Efforts
OBPR life sciences strategy should integrate multiple levels of analysis, (i.e., organismal, systemic, cellular, molecular).
OBPR physical sciences strategy should coordinate the research efforts from Fundamental Microgravity, Engineering, Commercial Engineering, and Technology Development where it makes sense.
Examples: combustion, fire safety
Rationale:
• Coordinated strategies focused on specific problems would optimize research productivity.
53

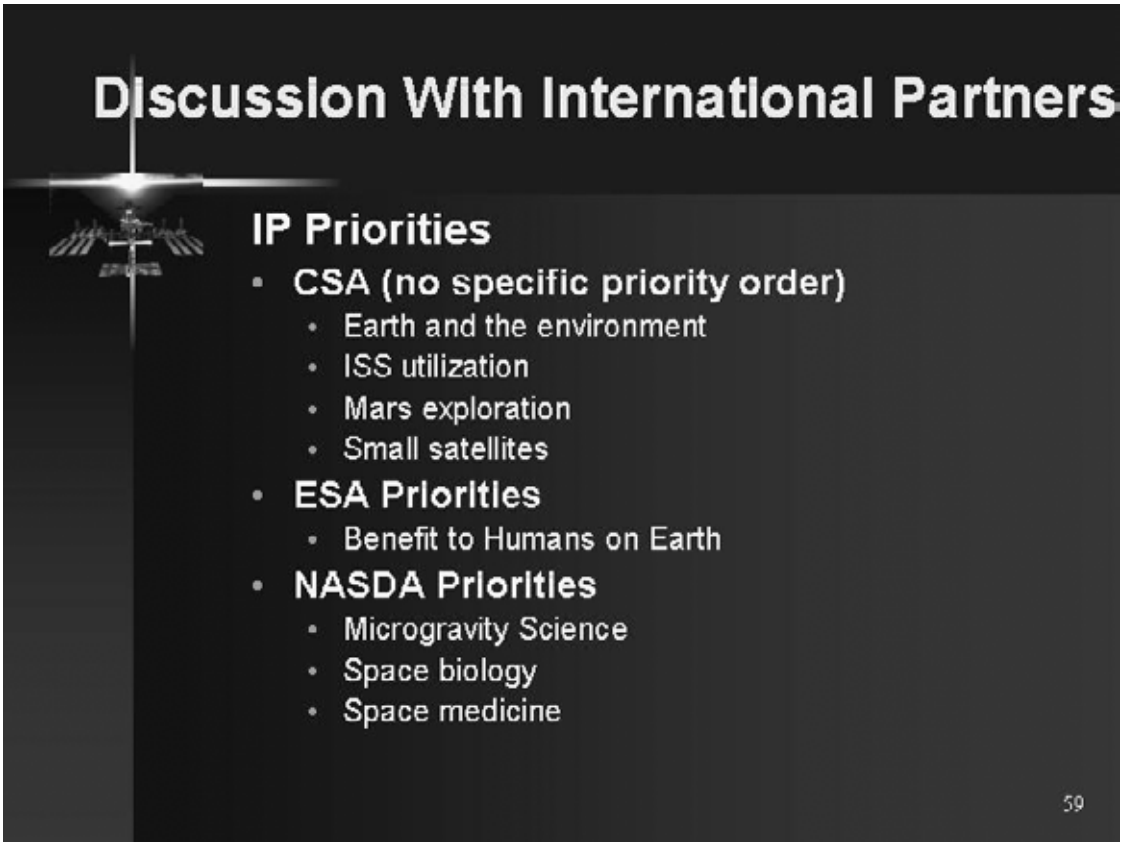

Recommendation: Potential New Lines of Research
OBPR should examine potential lines of research outside of the current research portfolio.
Rationale:
• REMAP Task Force prioritized only the current research portfolio.
54

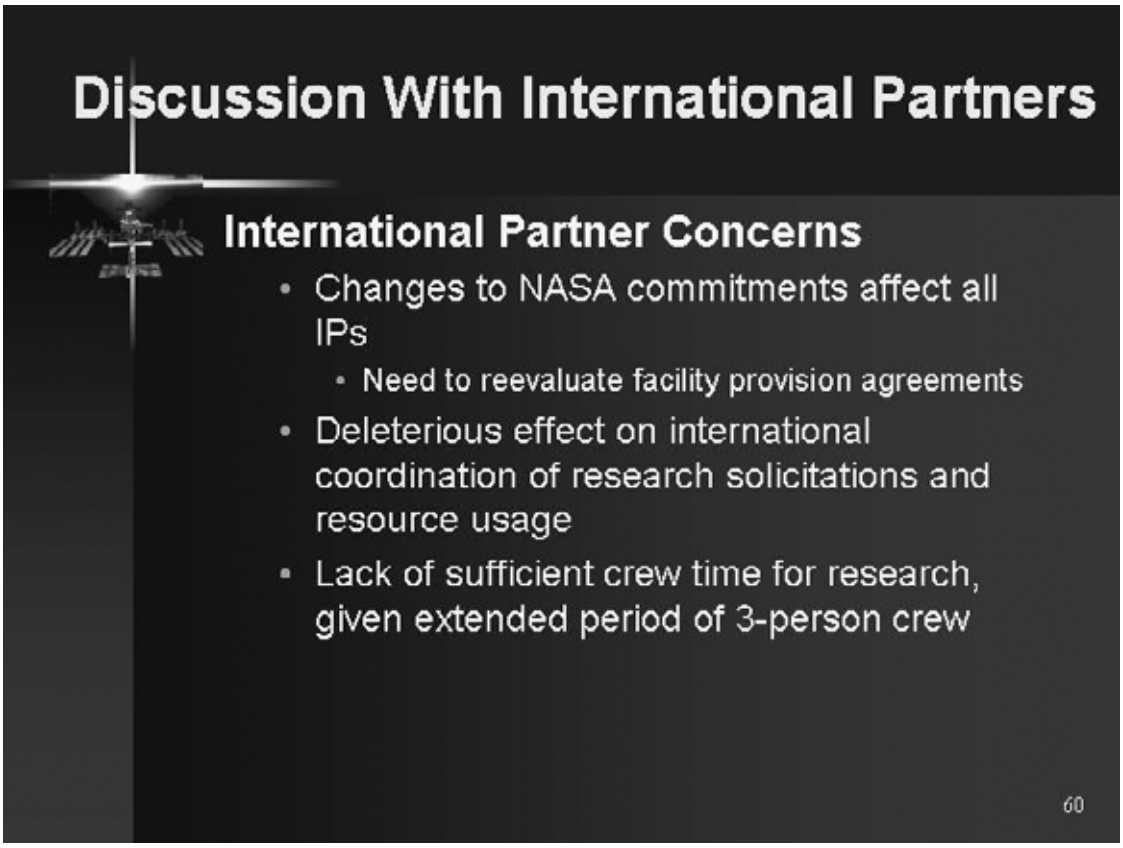

Recommendation: Metrics
Given that NASA has multiple requirements for producing and reporting productivity metrics, the purpose of each metric should be clearly delineated such as science productivity, education outreach, and public affairs.
Rationale:
Specific metrics, even when accurate, do not necessarily index the measure of interest. For example, media attention is not suitable for evaluation of scientific quality.
55

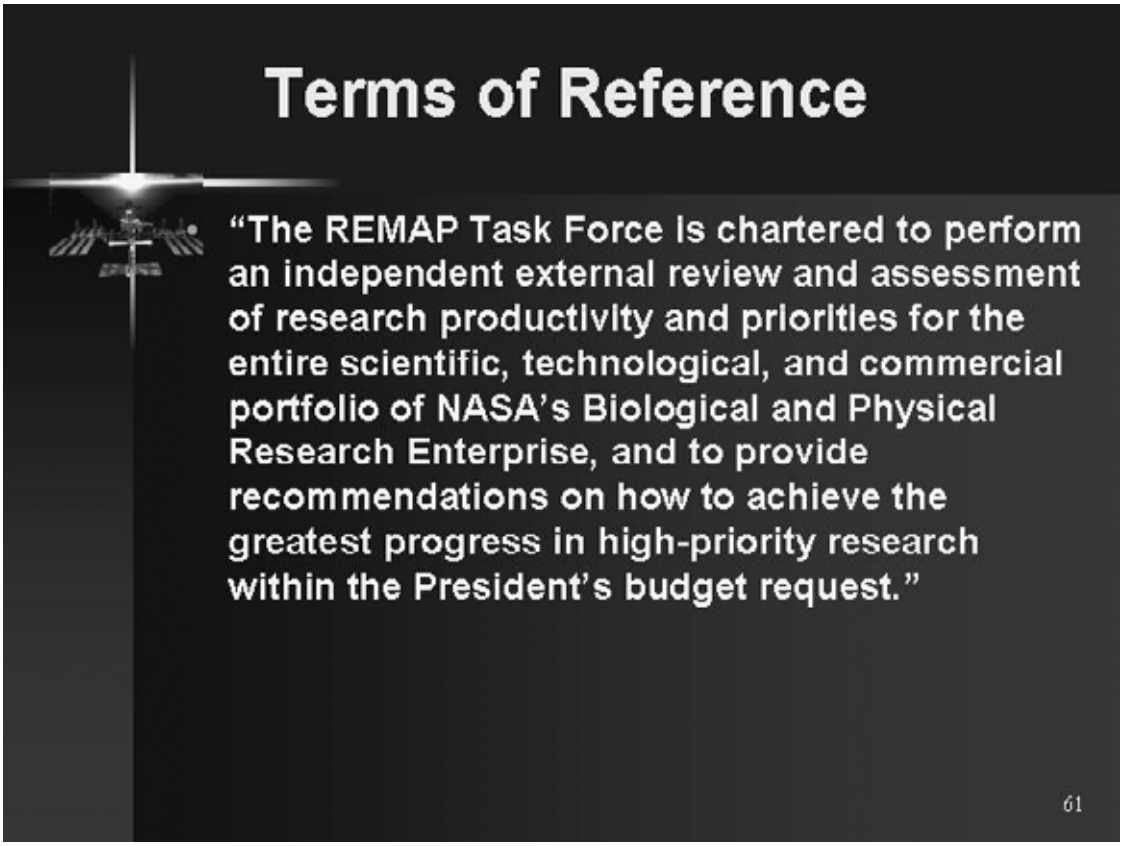

Recommendation: Coordination with International Partners
NASA should continue coordination of facilities development and research solicitations with the International Partners, and attempt to address the International Partner concerns.
Rationale:
IPs have chosen to build certain ISS research facilities and not others to avoid replication based on understanding of shared facility utilization
IPs have continued interest in coordination with NASA and submitted analyses of their priorities and concerns to REMAP
56

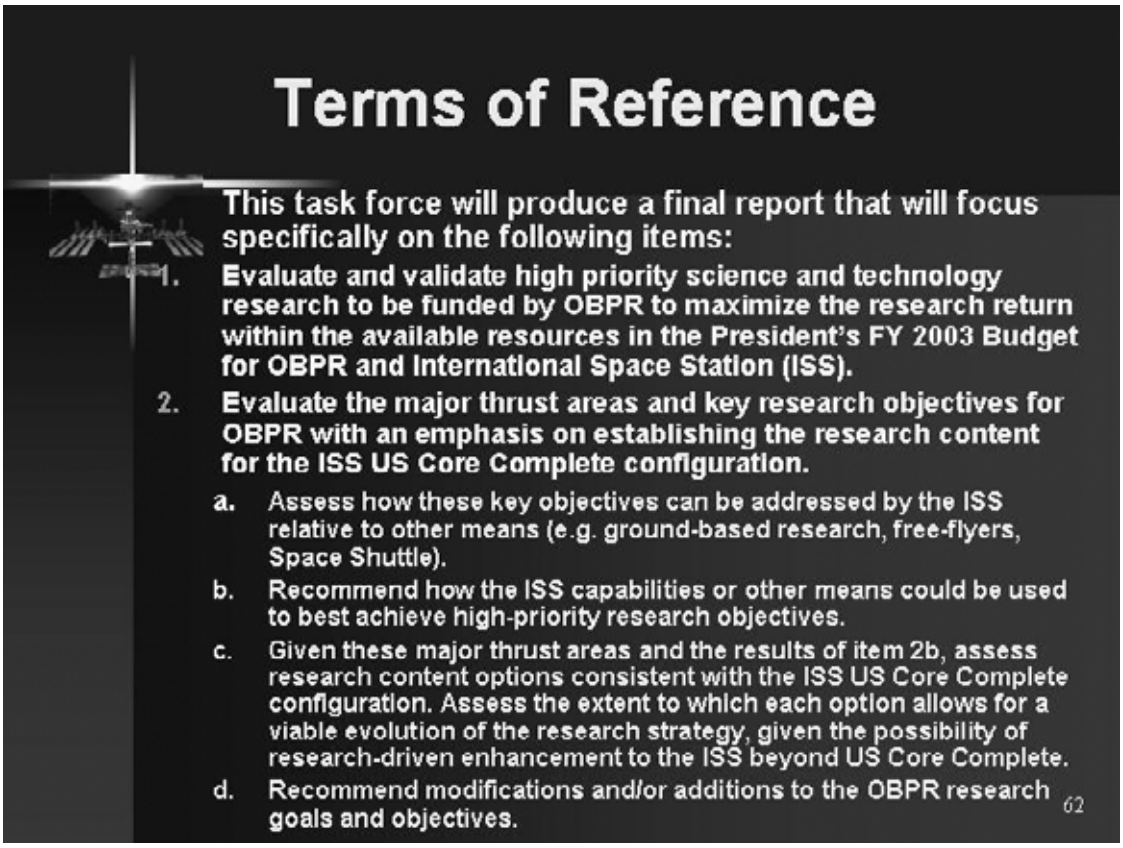

Summary
ISS is unprecedented as a laboratory and is the *only* available vehicle for human tended research on long-duration effects of microgravity.
57

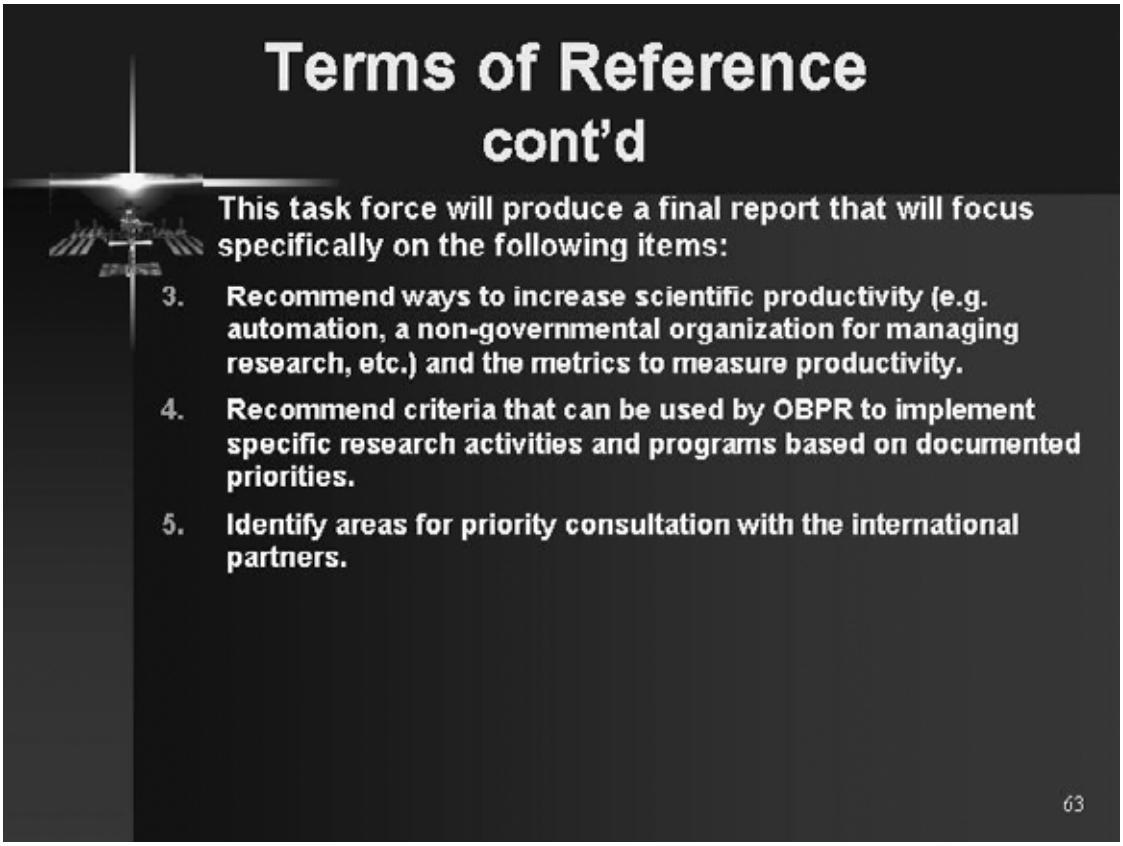

Appendices
58

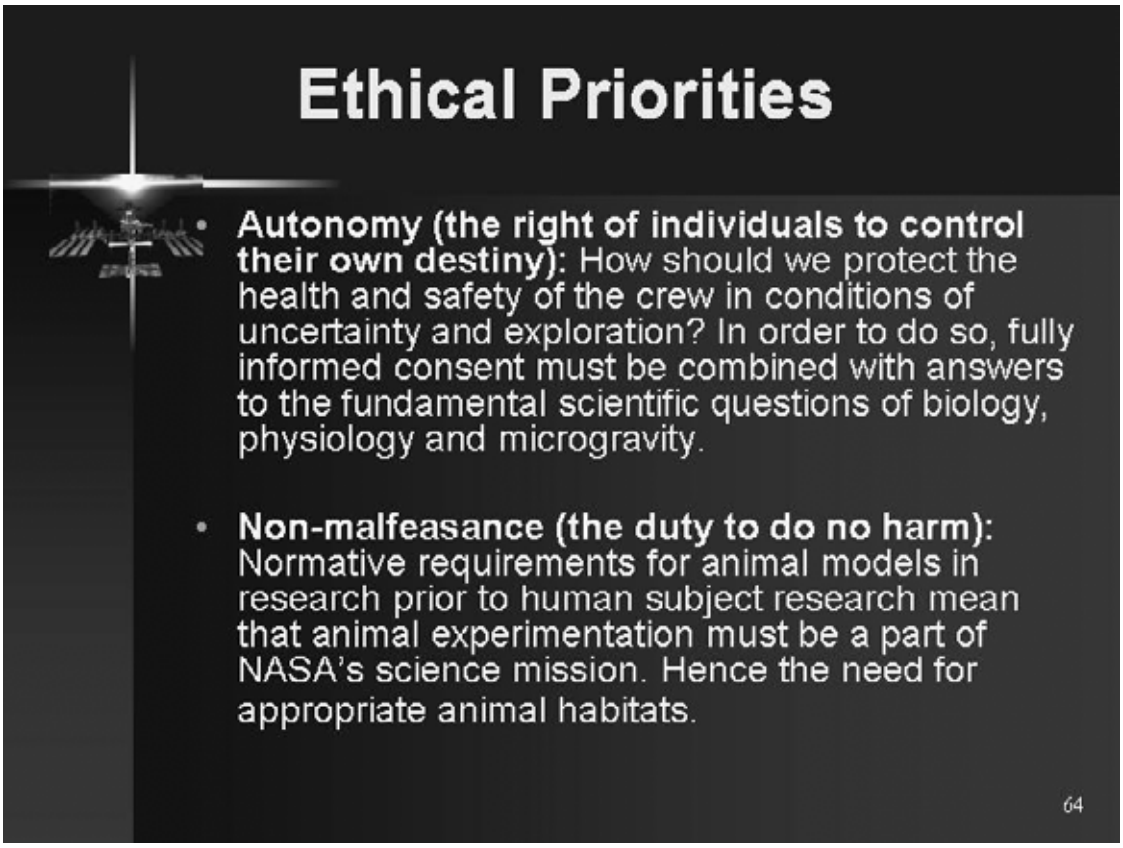

Discussion With International Partners
IP Priorities
CSA (no specific priority order)
Earth and the environment
ISS utilization
Mars exploration
Small satellites
ESA Priorities
Benefit to Humans on Earth
NASDA Priorities
Microgravity Science
Space biology
Space medicine
59

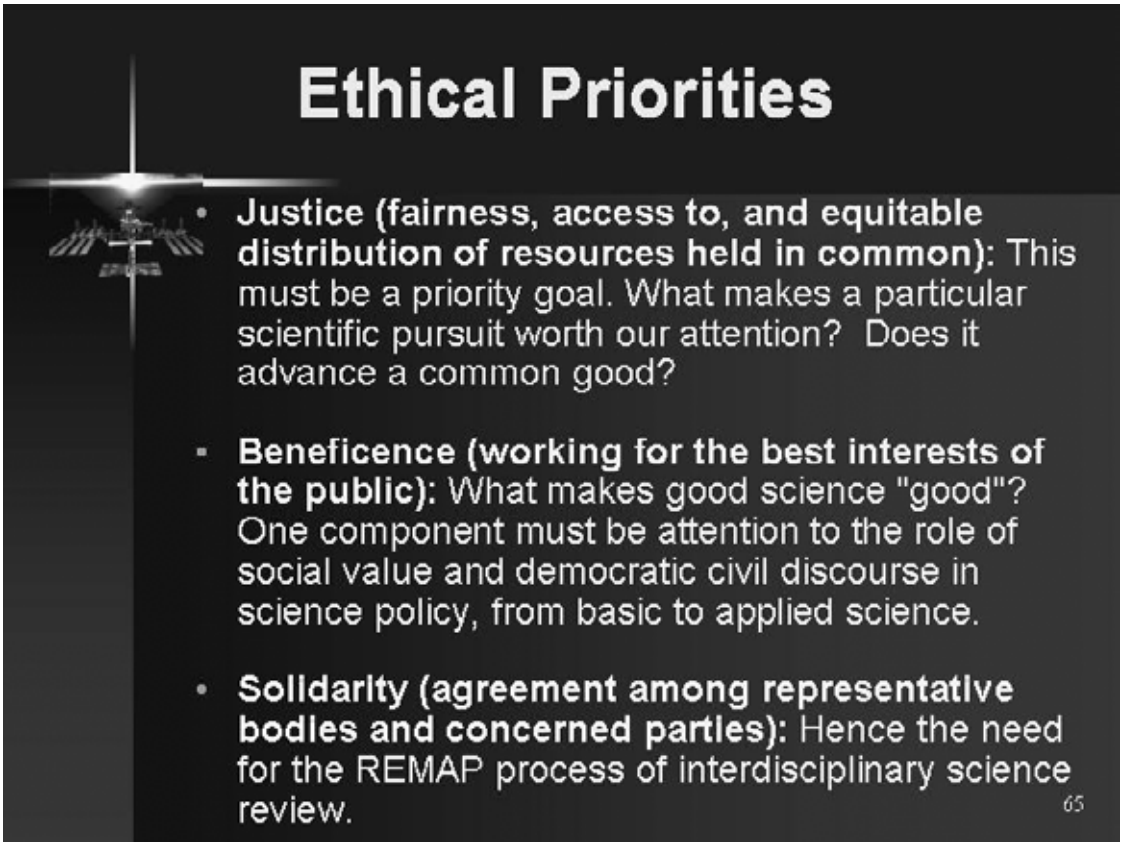

Discussion With International Partners
International Partner Concerns
Changes to NASA commitments affect all IPs
Need to reevaluate facility provision agreements
Deleterious effect on international coordination of research solicitations and resource usage
Lack of sufficient crew time for research, given extended period of 3-person crew
60

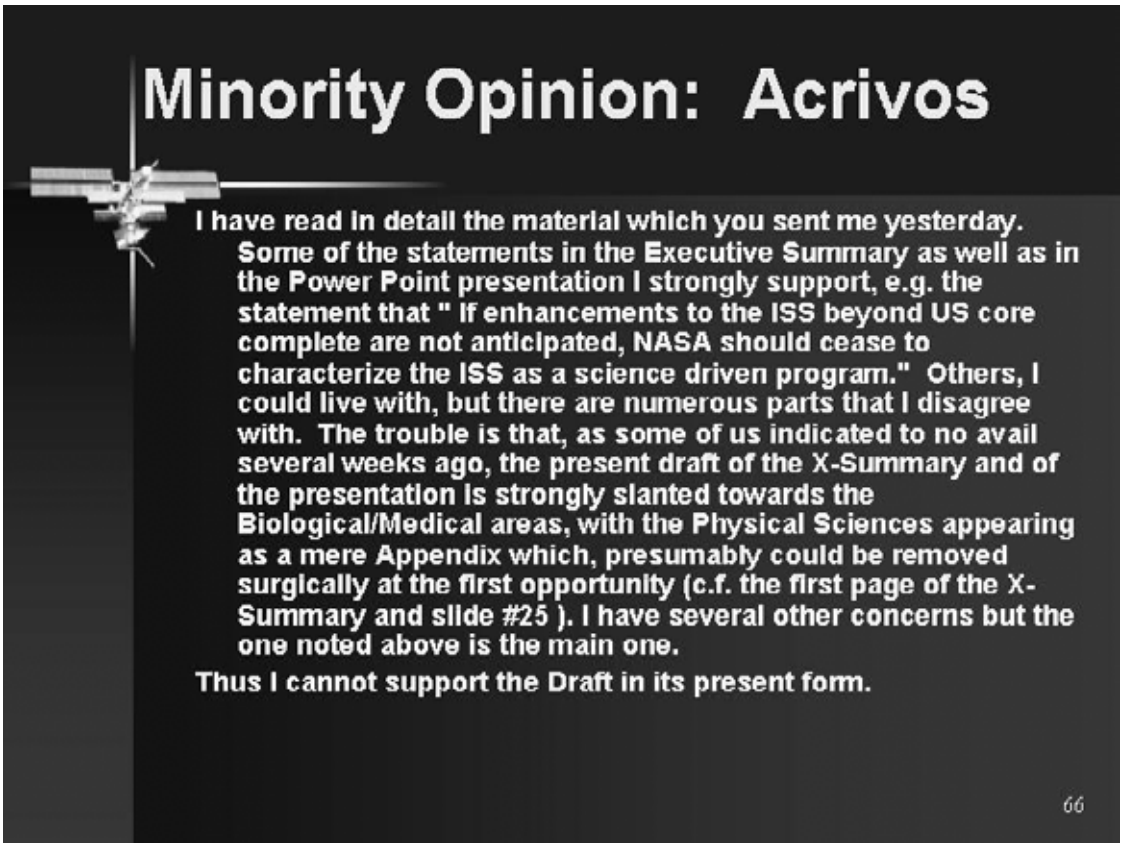

Terms of Reference
"The REMAP Task Force is chartered to perform an independent external review and assessment of research productivity and priorities for the entire scientific, technological, and commercial portfolio of NASA's Biological and Physical Research Enterprise, and to provide recommendations on how to achieve the greatest progress in high-priority research within the President's budget request."
61

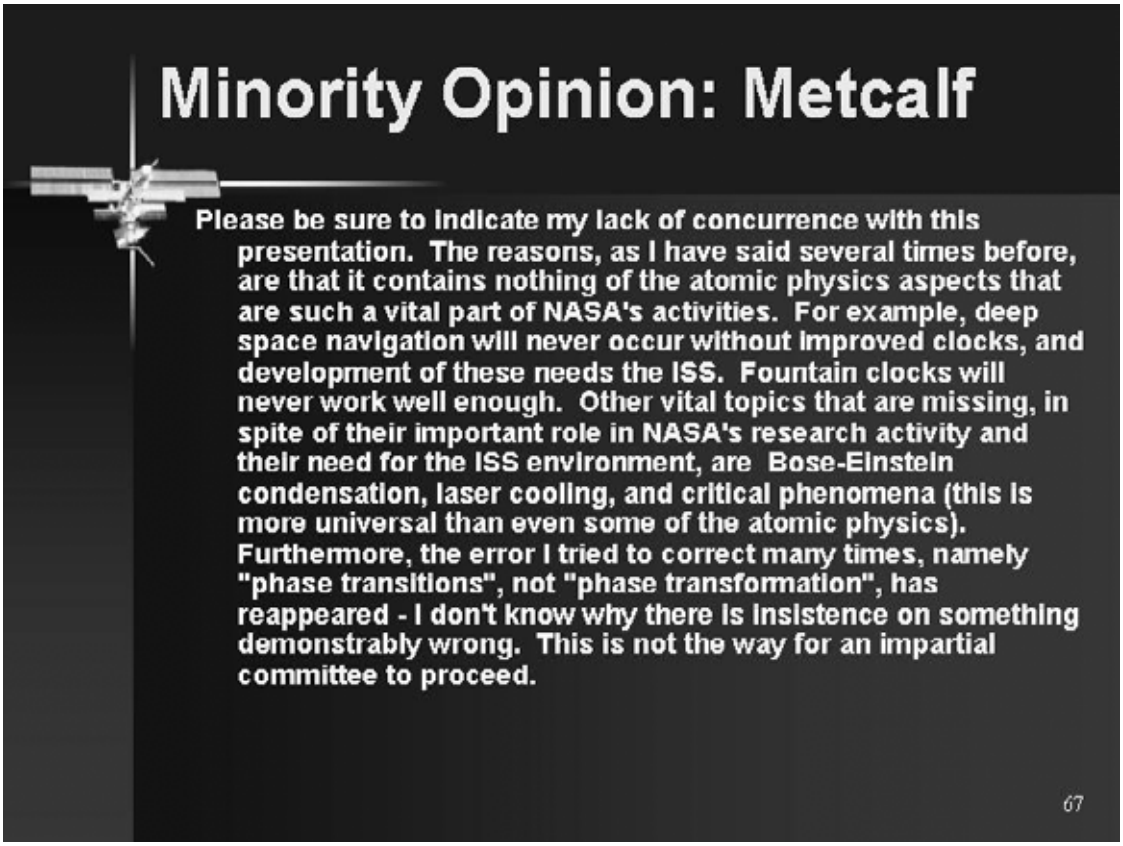

Terms of Reference
This task force will produce a final report that will focus specifically on the following items:
1. Evaluate and validate high priority science and technology research to be funded by OBPR to maximize the research return within the available resources in the President's FY 2003 Budget for OBPR and International Space Station (ISS).
2. Evaluate the major thrust areas and key research objectives for OBPR with an emphasis on establishing the research content for the ISS US Core Complete configuration.
a. Assess how these key objectives can be addressed by the ISS relative to other means (e.g. ground-based research, free-flyers, Space Shuttle).
b. Recommend how the ISS capabilities or other means could be used to best achieve high-priority research objectives.
c. Given these major thrust areas and the results of item 2b, assess research content options consistent with the ISS US Core Complete configuration. Assess the extent to which each option allows for a viable evolution of the research strategy, given the possibility of research-driven enhancement to the ISS beyond US Core Complete.
d. Recommend modifications and/or additions to the OBPR research goals and objectives.
62

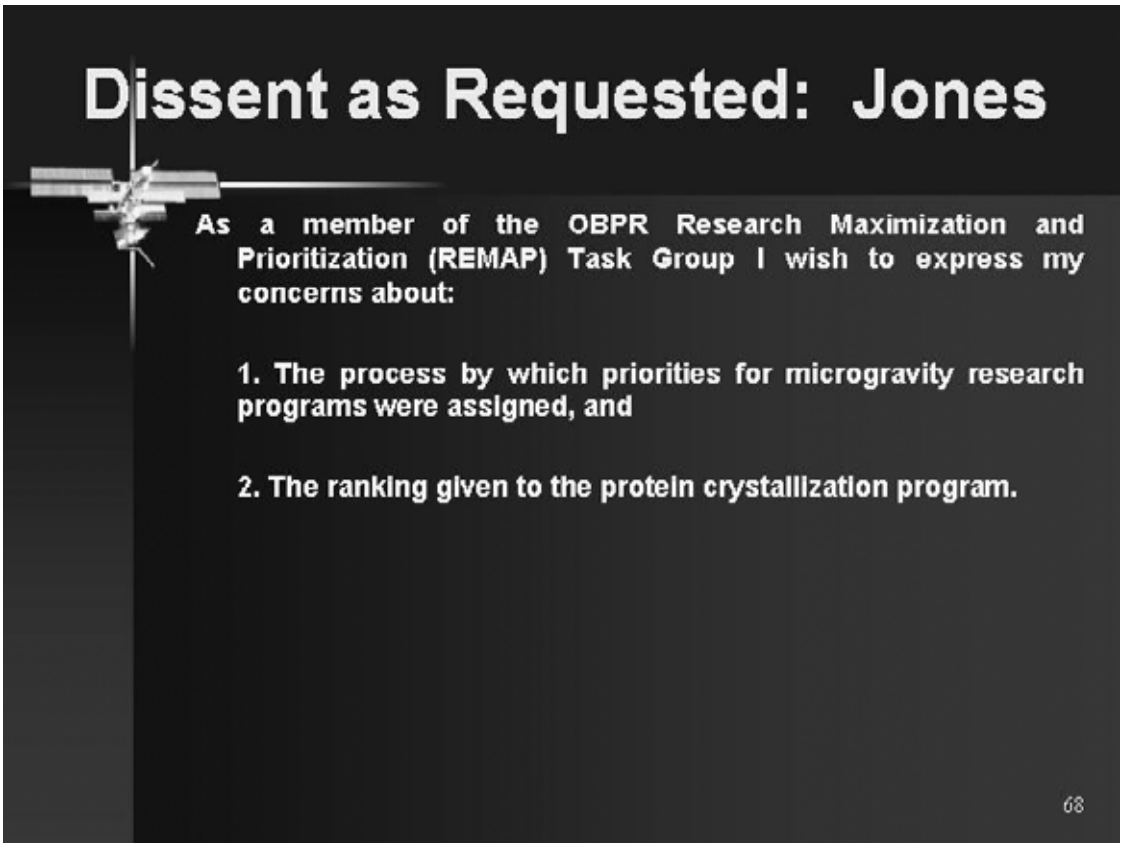

Terms of Reference
cont'd
This task force will produce a final report that will focus specifically on the following items:
3. Recommend ways to increase scientific productivity (e.g. automation, a non-governmental organization for managing research, etc.) and the metrics to measure productivity.
4. Recommend criteria that can be used by OBPR to implement specific research activities and programs based on documented priorities.
5. Identify areas for priority consultation with the international partners.
63


Ethical Priorities
• Autonomy (the right of individuals to control their own destiny): How should we protect the health and safety of the crew in conditions of uncertainty and exploration? In order to do so, fully informed consent must be combined with answers to the fundamental scientific questions of biology, physiology and microgravity.
• Non-malfeasance (the duty to do no harm): Normative requirements for animal models in research prior to human subject research mean that animal experimentation must be a part of NASA's science mission. Hence the need for appropriate animal habitats.
64


Ethical Priorities
Justice (fairness, access to, and equitable distribution of resources held in common): This must be a priority goal. What makes a particular scientific pursuit worth our attention? Does it advance a common good?
Beneficence (working for the best interests of the public): What makes good science "good"? One component must be attention to the role of social value and democratic civil discourse in science policy, from basic to applied science.
Solidarity (agreement among representative bodies and concerned parties): Hence the need for the REMAP process of interdisciplinary science review.
65


Minority Opinion: Acrivos
I have read in detail the material which you sent me yesterday. Some of the statements in the Executive Summary as well as in the Power Point presentation I strongly support, e.g. the statement that " If enhancements to the ISS beyond US core complete are not anticipated, NASA should cease to characterize the ISS as a science driven program." Others, I could live with, but there are numerous parts that I disagree with. The trouble is that, as some of us indicated to no avail several weeks ago, the present draft of the X-Summary and of the presentation is strongly slanted towards the Biological/Medical areas, with the Physical Sciences appearing as a mere Appendix which, presumably could be removed surgically at the first opportunity (c.f. the first page of the X-Summary and slide #25). I have several other concerns but the one noted above is the main one.
Thus I cannot support the Draft in its present form.
66


Minority Opinion: Metcalf
Please be sure to indicate my lack of concurrence with this presentation. The reasons, as I have said several times before, are that it contains nothing of the atomic physics aspects that are such a vital part of NASA's activities. For example, deep space navigation will never occur without improved clocks, and development of these needs the ISS. Fountain clocks will never work well enough. Other vital topics that are missing, in spite of their important role in NASA's research activity and their need for the ISS environment, are Bose-Einstein condensation, laser cooling, and critical phenomena (this is more universal than even some of the atomic physics). Furthermore, the error I tried to correct many times, namely "phase transitions", not "phase transformation", has reappeared - I don't know why there is insistence on something demonstrably wrong. This is not the way for an impartial committee to proceed.
67


Dissent as Requested: Jones
As a member of the OBPR Research Maximization and Prioritization (REMAP) Task Group I wish to express my concerns about:
1. The process by which priorities for microgravity research programs were assigned, and
2. The ranking given to the protein crystallization program.
68